Tappi

PUBLISHED BY THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY

APRIL 1953

. . . *the mark of an outstanding moto*

The familiar L. A. that identifies each motor built by The Louis Allis Co. is more than a mere trademark. These two distinctive strokes formed the signed initials of Louis Allis—our founder and first president. He used them to signify approval on the many matters that crossed his desk each day.

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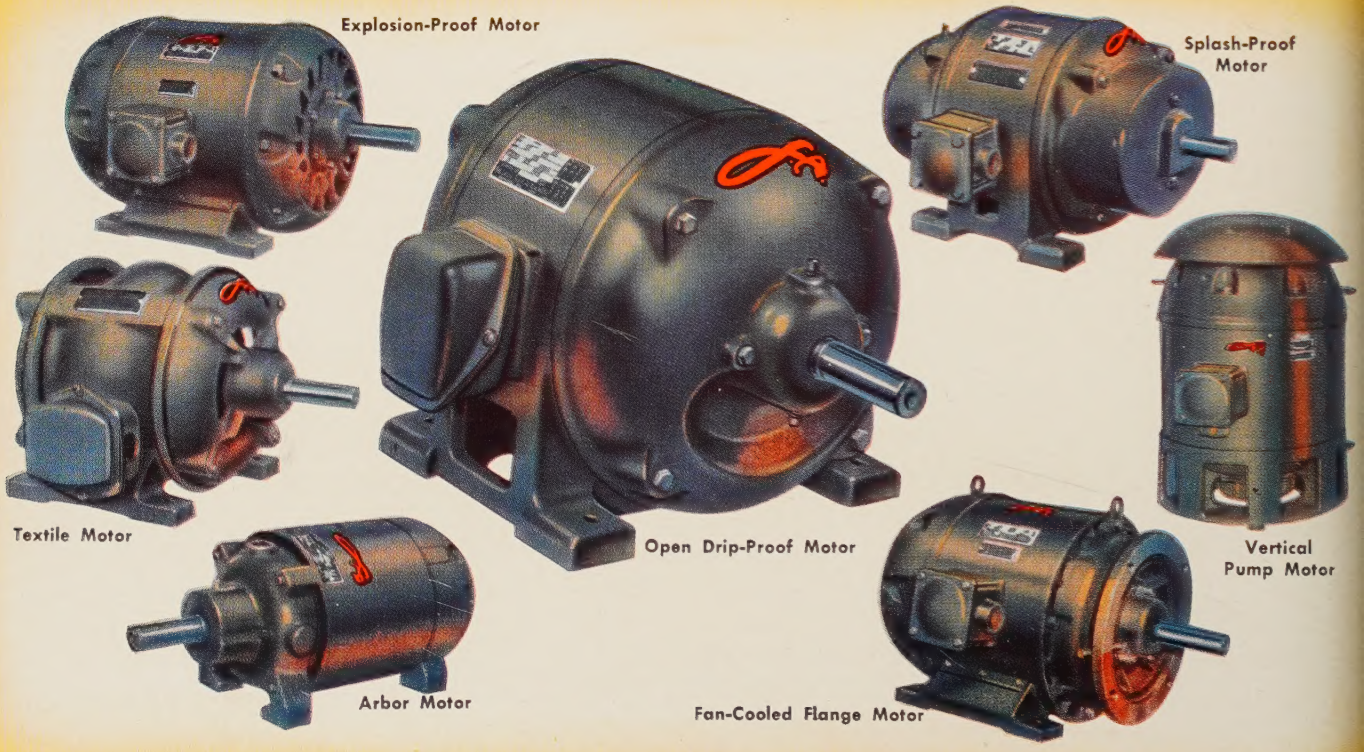
You can't go wrong when the motor for *your* job carries the famous L. A. Trade-mark. Always look for it.

IN101



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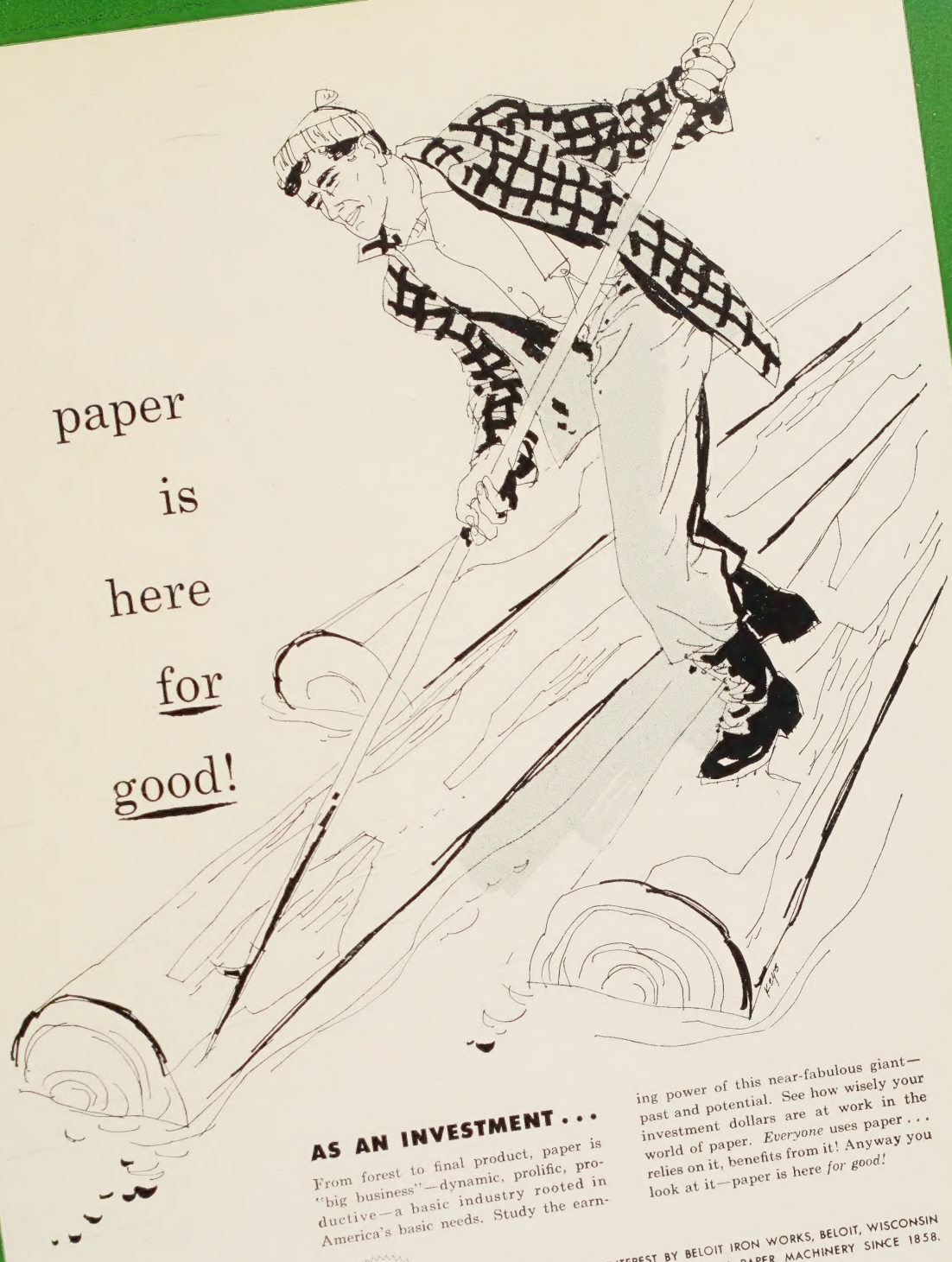

paper is here for good!

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From forest to final product, paper is "big business"—dynamic, prolific, productive—a basic industry rooted in America's basic needs. Study the earning power of this near-fabulous giant—past and potential. See how wisely your investment dollars are at work in the world of paper. *Everyone* uses paper . . . relies on it, benefits from it! Anyway you look at it—paper is here *for good!*

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PREPARED IN THE PUBLIC INTEREST BY BELOIT IRON WORKS, BELOIT, WISCONSIN
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One of countless applications of Ohm's Law is found in the electric toaster, where heat is built up by increasing resistance to the current.
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THE DISCOVERY that certain papers have excellent food protection properties has contributed substantially to progress in the food industry. So has the development of colorful wrappers that attract more customers at the point of sale.
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...AND ONE BASIC FOR KVP IS HUBER FILLER CLAY!

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3. Particle Size	7. Gloss	11. Abrasion
4. pH	8. Opacity	12. Moisture
		13. Suspension

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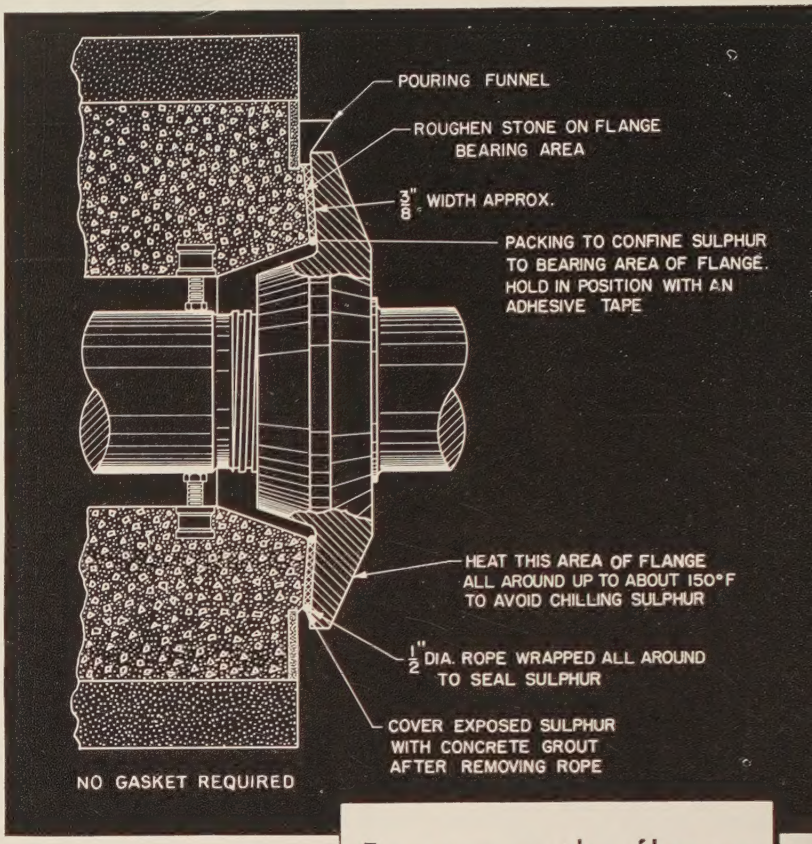
A Suggested Method of Mounting Pulpstones


POURING FUNNEL
ROUGHEN STONE ON FLANGE BEARING AREA
⅜" WIDTH APPROX.
PACKING TO CONFINE SULPHUR TO BEARING AREA OF FLANGE. HOLD IN POSITION WITH AN ADHESIVE TAPE
HEAT THIS AREA OF FLANGE ALL AROUND UP TO ABOUT 150°F TO AVOID CHILLING SULPHUR
½" DIA. ROPE WRAPPED ALL AROUND TO SEAL SULPHUR
COVER EXPOSED SULPHUR WITH CONCRETE GROUT AFTER REMOVING ROPE
NO GASKET REQUIRED

Easy to Mount

and even more important

Easy to Remove

THE method of mounting a pulpstone shown in the drawing has been used in European mills for several years and has recently been adopted by a number of American mills. It has proved so successful wherever it has been tried that we are illustrating it here so that you may use it if it appeals to you.

While a bevel flange is illustrated this method can be used with any type of flange

Norton Pulpstone Engineering Service can be of help to you in many ways, including the specifying of the right stone to produce just the type of pulp which you require.

NORTON COMPANY, WORCESTER 6, MASS.
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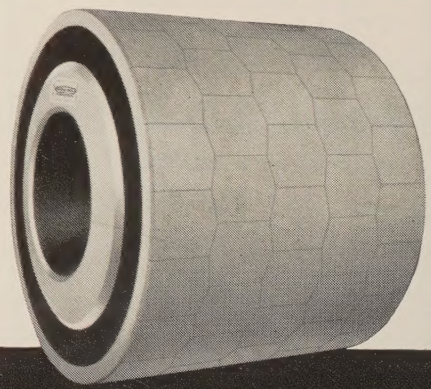
To remove the flanges the following method is suggested:

1. **Remove the cement grouting covering the sulphur**
2. **Heat the flange in the sulphured area until the sulphur melts**
3. **Then unscrew flange**



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for paper with plenty of fight

HYDROSEAL will increase the Mullen, fold, tear, pick and tensile strength of your paper. It requires no preparation. It is a cold water swelling starch that is added directly to the beater in dry form.

HYDROSEAL improves formation and scuff resistance of the sheet, and improves greaseproofness of glassine. It cuts white water losses by increasing retention of fillers and fines, lays fuzz, and gives a better surface.

HYDROSEAL gives you better retention of starch in the sheet, too. And it's versatile — works in all types of paper from high grade bond and book papers to Kraft. For example, it improves the Mullen and formation of ledger paper and increases the flat crush of corrugating medium.

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Samuel M. Langston Co.
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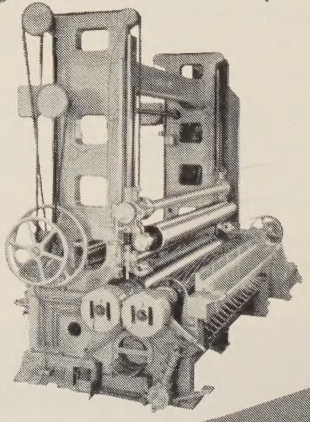
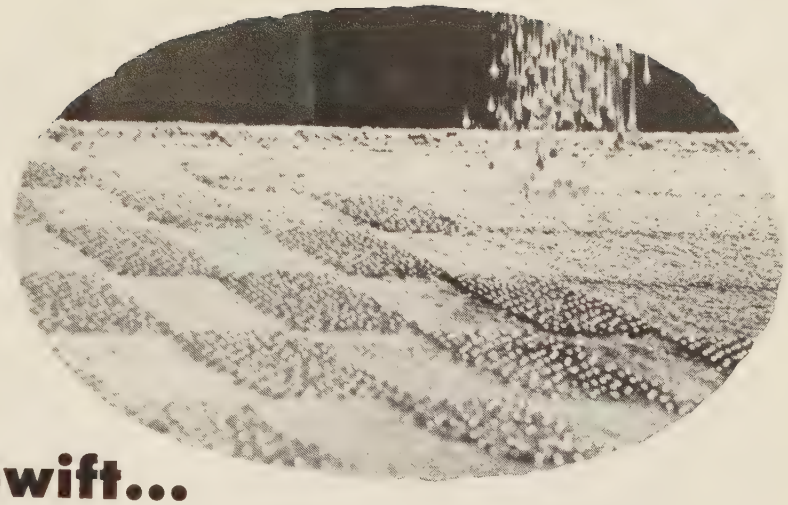


Shown here is one phase of Swift's exclusive process. The protein liquor falls on a bed of dry finished product.



Exclusive with Swift...

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Here's where Swift's New Process Glue serves the paper maker

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Adhesive Products Department
Chicago 9, Illinois

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Please send your 100-lb. introductory shipment of Swift's New Process Glue at the quantity price, to be tested for use in our operations. We understand, if not fully satisfactory, it may be returned for credit at your expense.

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*Firm Name*_____

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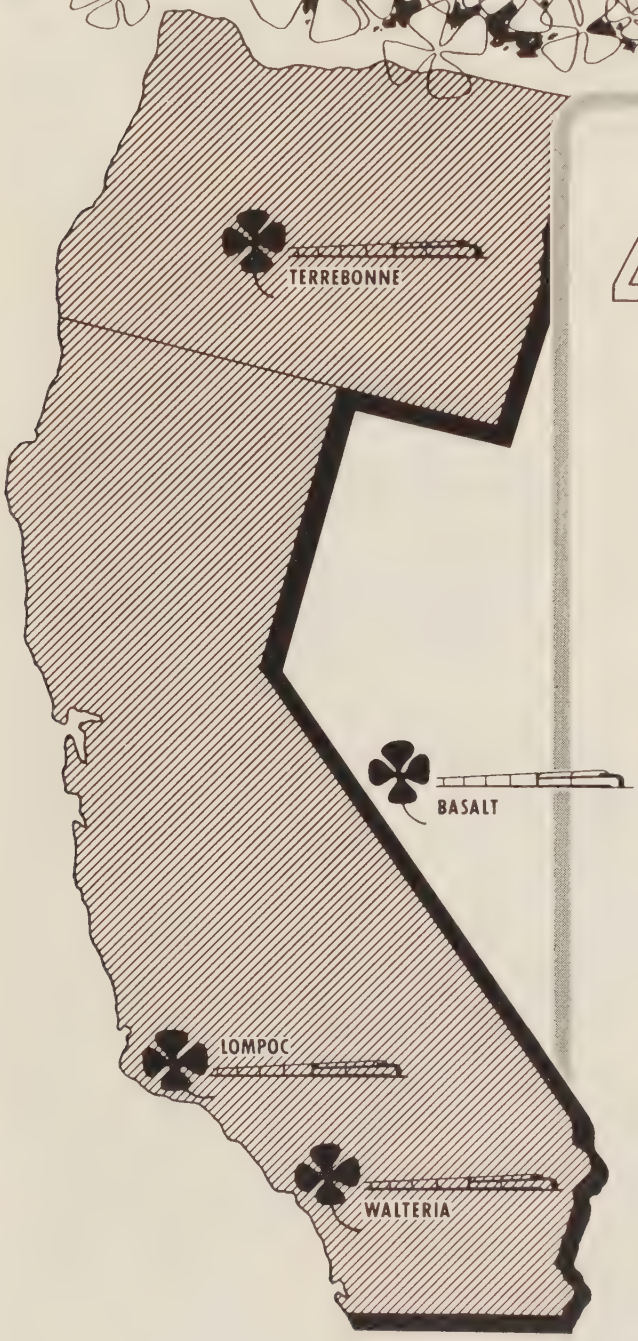
In this case, 4 IS THE LUCKY NUMBER



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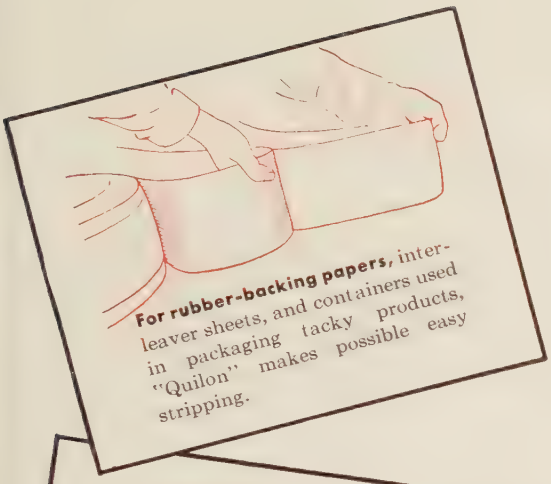
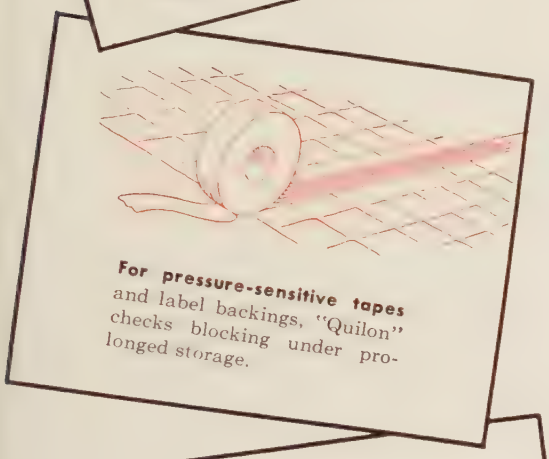
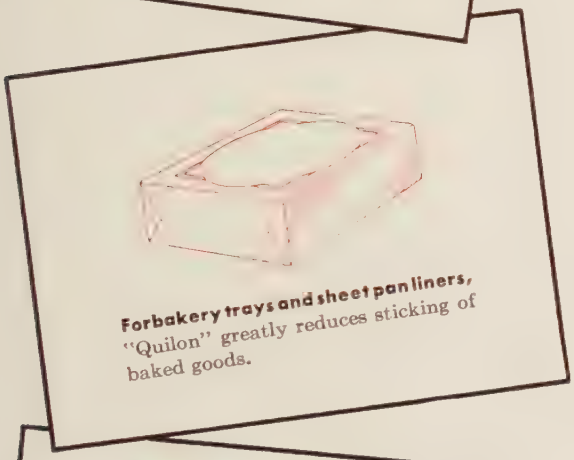


For rubber-backing papers, interleaver sheets, and containers used in packaging tacky products, "Quilon" makes possible easy stripping.



For pressure-sensitive tapes and label backings, "Quilon" checks blocking under prolonged storage.



For bakery trays and sheet pan liners, "Quilon" greatly reduces sticking of baked goods.

For meat and frozen-food wrappers and trays, "Quilon" eliminates paper adhesion to food, permits easy removal from package.

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stearato chromic chloride

You get a superior release treatment—at low cost—when you use Du Pont "Quilon" stearato chromic chloride. "Quilon" is non-migratory—anchors tightly to the fibers of paper, giving it release properties that last. Yet the cost is low because the amount of "Quilon" needed is so small.

"Quilon" can give your paper new sales features through its other outstanding properties, too. Use it to get excellent size and water repellency. "Quilon" doesn't give paper a waxy feel . . . doesn't adversely affect any dry properties of paper. "Quilon" also minimizes water sensitivity of many soluble or emulsion-type coatings and adhesives.

Easy to apply by spray, transfer rolls or immersion, "Quilon" can be used for treatment at the size press, at calender stack water boxes, or with converting equipment.

Send for technical bulletin *giving more facts and figures—uses and methods of application—on versatile Du Pont "Quilon." Mail this coupon now.*

"Quilon" is a registered trade mark of E. I. du Pont de Nemours & Co. (Inc)

E. I. du Pont de Nemours & Co. (Inc.)
Grasselli Chemicals Department
Wilmington 98, Delaware

Please send me free technical bulletin describing "Quilon" stearato chromic chloride.

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*Firm*_____

*Address*_____

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BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

MORE AND BETTER RESEARCH

FRANCIS J. CURTIS

Francis J. Curtis

JUST as everyone is against sin—at least publicly—so I suppose that everyone will unhesitatingly be for better research but some may question the necessity or the value of more research. It seems to me what we have to look at is not the over-all figures, although they are interesting, but what we might call the distribution curve. All of us are familiar with the Englishman and his umberella, and those of us who have been in England come quickly to recognize the reasons for the national habit. It certainly seems to manage to rain somehow some part of every day, yet rarely do you see a downpour of the type we are all so accustomed to in this country. Actually, the average rainfall in London is 24½ i.p.y. and in Ohio 35.4 in., so that theoretically Ohio is actually a wetter country than England, yet in practice, the distribution of the English rains is so efficient that crops and gardens grow with almost no attention, but the daily umbrella is a necessity.

So we have to consider not only the total amount of expenditures on research in the United States of America but where they are spent and how they are spent, and we may easily find that there are bare spots in our research economy. It may well be that whole industries are not getting proper research attention. Therefore, it is poor policy to sit back and say that everyone in the country is spending enough on research.

U. S. OVER-ALL EXPENDITURES

The over-all figures are truly amazing and it is not to be wondered at the feelings of complacency which their perusal has aroused. The total amount of money spent for research in the United States has risen from $800 million in 1941, to $2930 million in 1952. I am sure that if any of the men in the early part of the century who fought so hard to establish research consciousness could see these figures, they would be truly astounded. I am also sure that they would be the first to say that we should not be bemused by these large figures and that it is not only the quantity which is expended but the efficiency thereof which counts.

FRANCIS J. CURTIS, Vice-President, Monsanto Chemical Co., St. Louis, Mo.

In 1952 the funds were expended as follows:

Industrial	$1820 million	62%
University	$280 million	9.6%
Federal	$830 million	28.4%

It is interesting to note, however, that the source of these funds was $1640 million or 56% from the Federal Government and the balance of $1290 million or 44% from other sources. In other words, much of the Federal expenditure is carried out in other laboratories than those belonging to the Government.

We must consider that a large portion of the Federal expense is on weapons of war which do nothing to increase our standard of living however necessary they are to maintain it. However, I think we can fairly say that the still large "other" expenditures together with portions of the Federal are unquestionably responsible for the big increase in the standard of living in the last 25 to 30 years.

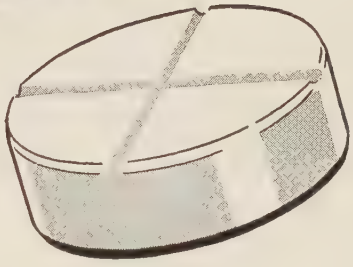
SPECIAL CASE OF THE CHEMICAL INDUSTRY

So much for over-all expenditures—their great size is interesting, instructive, and important but not decisive. I would like to talk to you for a few moments about research in the chemical industry, partly because that is the industry with which I am most familiar, and because it is the most active in the research field. The output of the chemical industry has expanded from $600 million in 1925 to $5500 million in 1950 both calculated in terms of 1950 dollars. This is a growth of nine times in 25 years. Looking at another set of figures—whereas all industrial capacity in 1950 was twice that in 1940, that of the chemical industry was three times—I think we can rightfully say that research works.

When we come to particular cases or individual companies and are asked the question, "How much should we spend?" we have no ready answer. There are at least three factors to be considered. First, the ability to do good research, second, the ability to raise money for plant installations, and third, the ability to obtain and train good personnel to operate them. You can see how rapidly these questions tie in with company policies. Certainly, if the company is not organized to do good research, whatever money is appropriated is likely to be wasted and might better be spend elsewhere. It is strange how often this apparent axiom is ignored by ambitious promoters who build beautiful laboratories to impress the bankers.

If the company is so situated that it is unable to carry our sufficient financing to build the plants which successful research demands, we have again complete ineffectuality. There is nothing worse for research

Vanzyme discs



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morale than to develop products and processes and have them pigionholed and, again, the expenditure might just as well never have been made. Finally, if proper personnel cannot be obtained and trained to operate these plants, we are again at an impasse. So, there is a great deal more to a research program than appears on the surface and much of it is not in the control of the research director at all. Before we think, therefore, of increasing our research, we should give important consideration to these other factors.

A recent survey of 39 companies in the chemical field showed an average of 5.2% of sales put into research. These companies varied through all the various categories of the chemical industry and the individual figures ran from a low of $1^1/_2$% to a high of 15.4%. If we eliminate three very large figures all above 10, the remaining 36 companies would average an expenditure on research equivalent to 4.5% of sales. The survey showed an intense degree of variation even in the chemical industry itself which confirms what we must expect to find in going from industry to industry. In our own case in Monsanto, we plan an average rate of 3% on sales year after year, under which conditions we can manage to keep the other financial and personnel factors in line, and we expand on the average at the rate of about 15% per year. I want to hasten to assure you that there is nothing sacrosant about the 3% figure. It has been arrived at by experience and by checking with other chemical companies of our type, some of whom spend a a little more and some a little less. It should be quite obvious to anyone that a company making sulphuric acid will have a very much smaller expense for research than one preparing pharmaceuticals. One thing we are sure of and that is while we say we spend 3% of sales, we do not allow that figure to rise and fall with the sales curve. We have long since found that the cat-and-mouse type of research does not pay. You cannot build an organization and turn it on and off like a water spigot. You can do it of course, but you would be better off to go in some other business.

Information on research expenditures in other industries is thin. At the present time an exhaustive survey is being made by the N.A.M. Research Committee from which we hope to get some idea of what other industries are spending in the field. There was an article, however, in *Chemical Week* published on Oct. 27, 1951, by George Perazich of Straus & Perry which took a somewhat different point of view in calculating research expenditures. This was a study of the petroleum, rubber, and chemicals and allied products industries. The latter group, chemicals and allied products, is one of the standard classifications in the census figures, and includes, besides the chemical industry proper of which I have been speaking heretofore, a number of allied industries including petroleum and rubber, such things as glass, leather, and others —so that the figures for chemicals and allied products are not the same as those for the chemical industry itself. The study was based on the number of research staff per ten thousand production workers in 1950 and on the assumed figure of a cost of $7000 per man. On these bases for 1950 the following figures were given:

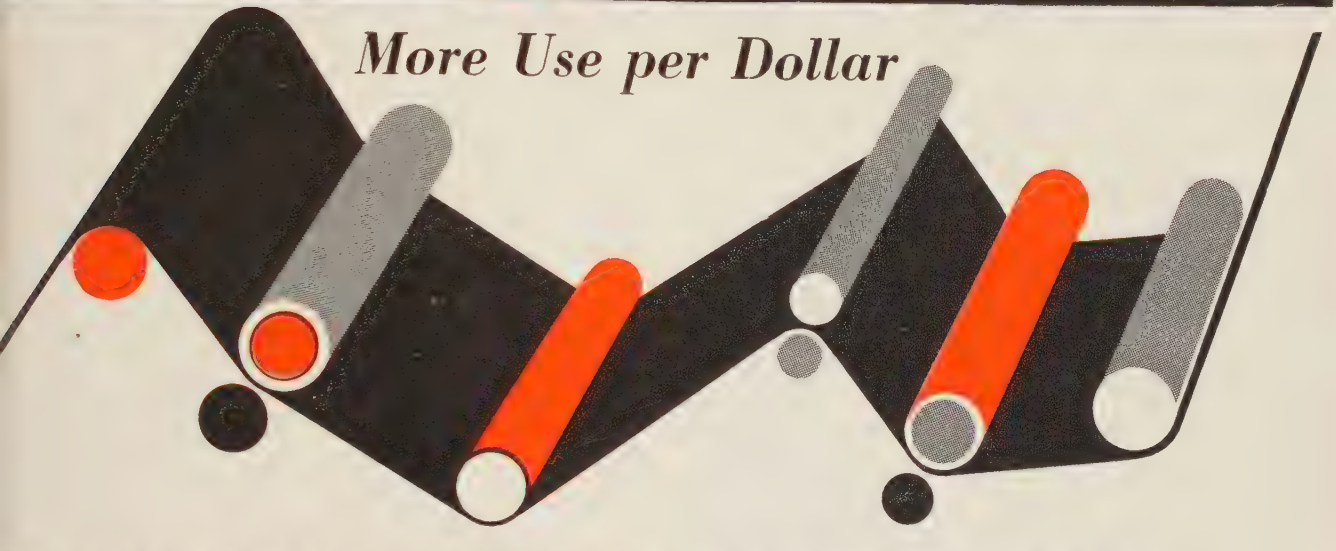
	Research staff/10,000 production workers	*Expenditures/$ output, %*
Chemicals and allied products	700	1.55
Petroleum	900	0.6
Rubber	190	0.63
All manufacturing industry	130	

These figures show that it is impossible to translate directly such norms as per cent on sales from one industry to another as the output per worker varies in different types. Each must work out its own and compare only with those closest to it in type of manufacture.

POSSIBILITIES OF THE PAPER INDUSTRY

Many people are prone to say that the chemical industry has the best chance to use research because of the constantly widening and growing fields in which it is engaged. Personally, I feel that they are confusing cause and effect. It is precisely because the chemical industry does put so much money into research that its fields are constantly widening and broadening. Even though many years ago I was a member of your association, I feel a little hesitant about talking on the possibilities of the paper industry in front of a group who are experts on that subject. Nevertheless, it is almost an axiom that whenever you have low yields you have an opportunity. I would like to suggest, therefore, that the low yields of salable products from wood plus the large degree of unsuccess in recovering by-products show the need of an entirely new approach to pulping. The recovery of vanillin and the fermentation of sugar are good starts but don't solve the problem. I noticed recently that the Industrial Chemical Sales Division of the West Virginia Pulp & Paper Co. are advertising a polyalcohol called "Indulin" which, I presume, is recovered from the by-products of their paper operations. These are good indications but I would like to suggest that maybe we need a fresh start. I don't know whether any of you are addicted to the vice of double crostic puzzles but I am, and I often made a wild guess and put it on the chart; then by being there it seems to acquire some validity and often until I force myself to rub it out and start over again, I can achieve no success in solving the puzzle. We have had the drastic treatment in use for obtaining cellulose for many years, and in large measure the cellulose is obtained at the expense of everything else. I am sure that many of you have been interested in the point of view taken in coal hydrogenation by the Carbide & Carbon Chemicals Corp., namely, that the treatment should be as mild and least destructive as possible in order to achieve the highest yields of valuable products. So I say that the door of opportunity is always wide open when yields are low but that so much work has been done unsuccessfully on by-product recovery that it would appear that something more radical is needed, and I rate this problem as probably one of the biggest opportunities in industry today.

We should have a greater marriage of paper and plastics to produce compounds different from either, The whole textile world is open to products made by felting rather than weaving, if proper ones can be produced. Who would have thought 25 years ago that



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the glass industry would be making glass into fibers, combining them with plastics and producing pipe fittings. The same thing is true of the synthetic fibers; many of them are believed to be most valuable in conjunction with the older, natural fibers. What will they do to paper?

We should look at papermaking as a process rather than a means of producing something to wrap with or to write or print on, and our question for research is, how far can this process be extended to make new articles of commerce? I agree that this is fancy chasing to a great extent and my only thought is to express to you the feeling that fancy chasing sometimes pays when backed up by a lot of good hard sensible work.

BETTER RESEARCH

We have been discussing largely the question of more research from the standpoint of quality and opportunity, and I hope I have made you feel that there is at least a good chance that more research would pay off. Let us now look at the other side of the picture and see what we can do to carry on better research. Obviously, one of the first questions that arises is the type of organization. It would be very nice to be able to give a pat answer to this, as it would be to so many other questions, but, unfortunately there is none. There are a few principles, however, that seem to run through the most successful organizations. The small company will, obviously, have one centralized laboratory so that organization becomes simple. Larger companies have a choice and may put all of their eggs in one basket in a central laboratory or may split them up into laboratories for their various divisions. The latter form of organization has the advantage of bringing the research worker closer to production and more able to take advantage of the skills of the production experts, which can be very helpful in any research program.

Whatever type of organization is adopted, however, there is one thing we are sure of, namely, that the head of research, whether he be a vice-president or director of research or what, should be on an absolute par organization-wise with the corresponding heads of production and sales, and should come directly under top management. The days when research was a hole-in-a-corner operation have long since gone by in any company which has made it a success. Another almost mandatory technique is the use of a planning group, meeting periodically and containing representatives of top management, production, sales, engineering, as well as research. Operation in a vacuum is inclined to dry thinking up. The subgroups in research may be organized product-wise or functionally; that is, we can conceive that there will be a group on each type of product made by the company or conversely we might have a group on pulping and another on papermaking, both of which could be subdivided and pay attention to the functions of their particular steps throughout a varied number of operations.

When it comes to personnel, above all things buy brains not hands. The quality of the personnel is far more important than the number, and investment in training will pay off many times. It is our opinion that the best basis for training is still the on-the-job-coaching of the younger by the older but that the key to this operation is in getting the older members, usually the group leaders, to take a real interest in producing men as well as things. A declaration of policy by the top management that a man's advancement will be conditioned to some extent by the kind of men he produces under him will have a profound influence in this regard.

In many cases there are monthly meetings of the groups, singly or together, where the research director or someone else keeps them up to date on company policies and activities. Seminars are extremely important, not only to the receivers but also to the givers and ofttimes I think more to the latter than the former. One of the most essential parts of any training system is the periodic interview of the superior with the men under him, where they are given a chance to assert their own opinions and ideas, and also to get from him his estimate of their efforts, and where both can frame together plans for the eradication of faults which have shown up. Here again the keynote is proper indoctrination of the superiors, not only from the standpoint of the importance of these interviews in the conduct of their jobs, but also in the methods of best handling them. The question of outside classes is a moot one in most companies. Unfortunatley, a good many plants are so located that no such classes are available. Where they are available, they should be taken advantage of, but in general we do not favor complete payment of tuition and expense by the company on the basis that nobody appreciates a free lunch. Volunteer classes organized inside the company from time to time on various subjects should be thoroughly encouraged.

It is highly desirable to send research men on their turn to technical meetings. All of us in contact with the same faces get too accustomed to them and we need to rub shoulders with others in fields often dissimilar to our own, in order to become stimulated and get new ideas. Maybe the research chemist will even get drunk, but at least he will get outside of his rut.

Probably the most important part of a research program is the choosing of projects. In most cases the technical part of the job will be well done and whether profitable results are achieved depends to a considerable extent on choosing the right kind of a project. Ideas for projects can come from any place, from the research staff as well as the other staffs of the company, from consultants, from outside projects presented, and maybe even from the Board of Directors. The great filter is the planning group mentioned above containing representatives of the various disciplines of the company. The research director should be the motivating force, and the measure of success is the number of projects that come through and bring in profits. No matter how well a scientific job is done, if it is an economic failure it is a failure.

The research director and his planning group must strike a careful balance between plant projects which are insurance that the present operations will be kept on a par with or, if possible, ahead of competitors, new products, and application work to back up sales. Good market research is essential in making a decision whether or not to embark on any project. To start off without knowing the potential size of the market, the type of customer to whom it is to be sold, and the price which the traffic will bear, is plain foolhardy.

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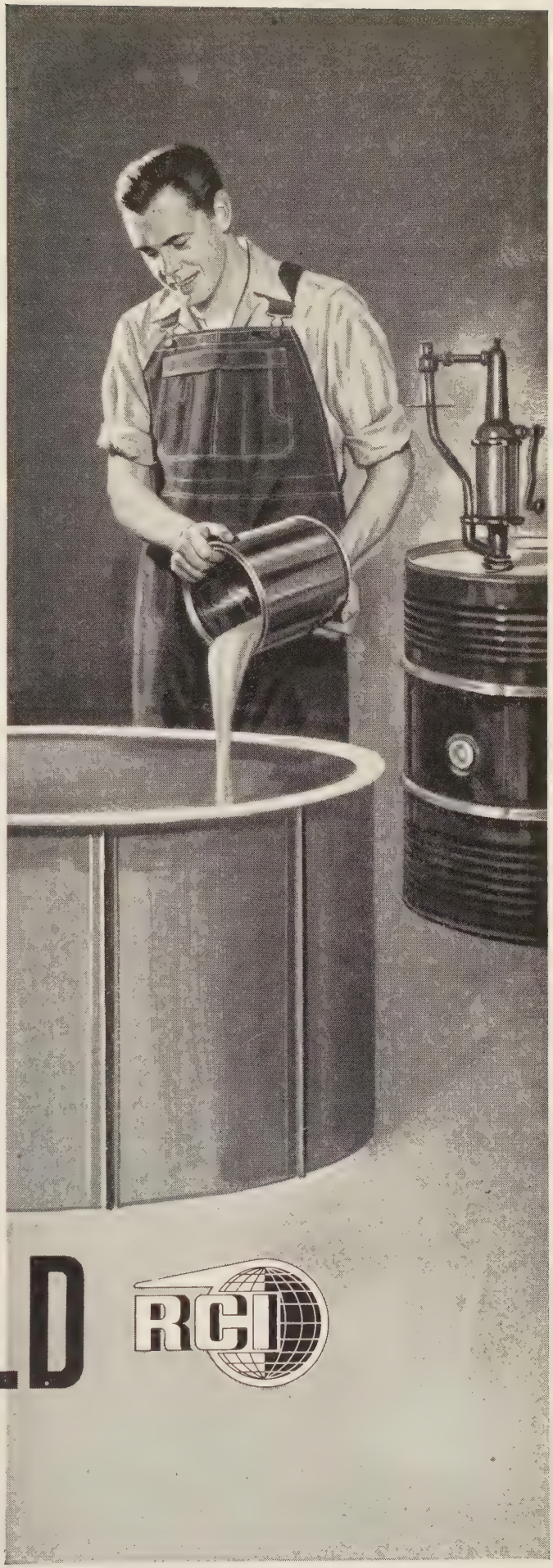

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Not only should market research be carried out in the beginning, but it should be checked from time to time, particularly before the larger expenditures usually incurred when going to the pilot-plant stage are contemplated. Such studies will give an idea of how much financing will be needed for a plant construction, and, if it is obviously beyond the means of a company at the time some other project had better be chosen. More than anything else, the research director must have the uncanny ability of knowing when to get rid of the dead horse, and I am afraid that is the subject on which no very good rules have yet been drawn up. There is a point of no return in research as in everything else and here the judgment of the research director is all important.

As soon as laboratory work has started, we believe it advisable to bring in the production men and acquaint them with the project and get their advice. Each company has in its membership certain skills and does not happen to possess certain others. A wise research program takes advantage of these skills and if they are not available looks again carefully at its project to see if it is big enough and important enough to go about acquiring them. Above all, one should not go to the pilot-plant stage until he is certain that no more information can be obtained on the bench scale or until he is forced to have the product available for sales development. There is a tendency in management, which should be strongly resisted, to feel that no progress has been made until a pilot plant is in operation. Nothing could be more untrue and many thousands of dollars can be wasted by finding out on the large scale what could just as well have been learned on the small.

In the bringing out of new products, the assistance of a good sales development group is essential. These are the people who carry the product from research through to the sales department. This group is sometimes organized under research, sometimes under sales, sometimes independently. Companies differ in their preferences and even some companies, like ours, do it in all three ways in different divisions. The sales development group is extremely important in keeping in close touch with the market which may even change while the research is in progress. The staff must be in constant contact with potential customers, know their processes, and be able to make trial runs of the new product. Sales development should try to work out the potential uses with one or two customers and then turn the product over to sales to carry it to all the potential customers. These projects become pet babies and there is always a tendency to feel that you should have just a little more information before getting the product out on the market, and since you can never have all the information about anything, holding back becomes a danger. Admittedly, one should not bring out a product prematurely but profits are not made in the sales development stage and the sooner the material can be placed in the hands of the sales department, the better.

On the production side, it has always been our custom that the research department demonstrates the new product or process in the plant with the assistance of the production staff but under the responsibility of research. Of course, many times new problems arise which may have to go back all the way to the laboratory bench but we strongly feel that the research organization should take responsibillty until a smoothly running production plant is in operation.

HOW MUCH DOES IT COST TO DO RESEARCH?

The article in *Chemical Week* in 1951 which I quoted above used a figure of $7000 per research worker. That means the total research budget divided by the total number of workers whether scientists or otherwise and includes everybody from the director to the janitor. Walter Whitman in another article in *Chemical Week* of July 7, 1952, stated from a study made by the Research and Development Board of the Department of Defense a figure of $8500 based on data from 42 industrial firms, 56 Federal organizations, and 51 universities and nonprofit organizations. It is obvious that these figures will vary from industry to industry but at least they do give us some idea of the size of a research budget. As far as the investment is concerned, the usual figure is $10,000 per scientist not per research worker but it is quite obvious that this figure will be larger for a small laboratory and smaller for a large one.

Many people bring up the question as to the value of outside research agencies. Of course, it is elementary to keep in touch with Government laboratories in the field of interest such as for paper, the Forest Products Laboratory. The difficulty with the results of Government laboratories is that they are available to everyone and few people wish to put in a lot of money on development work which can be easily reproduced by their competitors. The various research institutes of which Mellon Institute of Pittsburgh was the first and of which there are now many others, in various sections of the country, are now estimated to be spending about 40 million dollars on industrial research sponsored by industrial companies. They have an advantage, particularly for small companies who cannot afford heavy capital expenditures, even for large ones, to give opportunities for contacts with a large variety of specialists. They have the disadvantage of never being as close to the job as one's own employees. Somewhat the same condition exists with regard to consultants except that the latter are chosen usually for some specific skills which they have, not usually available in the more generalized institutes. Personally, I have always felt that there is a tendency never to tell the outside agency the whole story, which is a handicap to them and to oneself.

CONCLUSION

Money doesn't make a research program although one must admit that it is extremely helpful. Any concern who merely thinks that by appropriating a large sum of money, building a fine laboratory equipped with expensive gadgets, they are well into the research business, may impress investors but may not necessarily achieve results. Results come from men and their brains and a proper climate in which to exercise their talents. So, the ultimate responsibility for a successful research program rests with the management and the way research is organized, the policies of the company, and the handling of men. There is no substitute for brains.

PRESENTED at a meeting of the Ohio Section of the Technical Association of the Pulp and Paper Industry, Middletown, Ohio, Feb. 10, 1953.

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A TRADEMARK SKETCH FOR THE INDUSTRIAL MANAGER

ROBERT E. WOODHAMS

THE field of trademarks is generally recognized as a specialized, and often confusing, area of law. Nevertheless, the industrial manager frequently encounters trademark situations which require a careful, but sometimes immediate, answer to determine his company's conduct. This may happen at the beginning of a new business enterprise, or with the introduction of a new product by an established business. Whichever the case, any trademark lawyer's files are full of sad stories of trademark difficulties originating in ill-considered decisions made at such time.

There are a few basic considerations which can be readily remembered, and which should be remembered, by every industrial manager having any contact with trademarks, however infrequent, and if remembered will assist him materially in handling trademark problems. It is the purpose of this paper to set these forth.

A trade *mark* is an identifying badge applied to an article of commerce or to a service rendered in commerce. The badge may be a word, picture, or design. In some instances, as in radio programs, it may be distinctive sound.

A trade *name* is a name under which a business is conducted. The tradename and the trademark, in a given instance, may be identical or they may be different. For example, the corporation operating under the trade*name* of General Electric Co. sells lamps under the trade*mark* "Mazda," whereas the corporation operating under the trade*name* of E. I. du Pont de Nemours & Co. (Inc.) sells chemicals under the trade*mark* of "Du Pont."

One of the most important things to understand in the entire trademark picture is that the right to the exclusive use of a given trademark, is acquired by *actual use* therefore, and it is acquired to the extent, both as to goods involved and as to territory covered, of such actual use. The right to register a trademark, as is discussed later, is *not* necessarily the same as the right to exclusive use.

More specifically, if company X uses the trademark "Kwik" in the selling of a certain grade of paper and sells it only east of the Mississippi, the right of company X to the exclusive use of that trademark for that product is limited to the territory east of the Mississippi plus, under some liberal interpretations, to a few bordering states immediately west of the Mississippi. If company Y wishes to use the trademark "Kwik" for the same kind of paper in California, it is free to do so and company X can make no complaint. This situation is unchanged regardless of whether or not company X has registered its trademark either under the laws of the United States or under the laws of any single state. This is likewise not materially changed by national advertising on the part of either company, although the existence of national advertising may be accepted as improving the rights of company X if other factors are also present, such as company X having also made a few sales in California.

Therefore, when a company is newly formed, and a trademark is chosen upon which it is expected the company will base a major portion of its business, it is good practice for the company to make at least a few sales in as many parts of the country as possible at as early a date as possible, even if such sales are small and occur at infrequent intervals. The courts will go a long way in recognizing such sales in order to protect the truly first user of a trademark and permit him to cover as large a territory as his business reasonably requires.

One of the most important things in choosing a mark is the determination of whether the particular mark desired is available for use for the particular goods intended. Merely because the officials of the company contemplating the adoption of the mark are not themselves acquainted with any use of the proposed mark by other persons, by no means justifies the conclusion that there is no such other use. There may be another company, possibly a small one, in a nearby state producing substantially the same kind of goods under the same name. If both companies in question grow, they may eventually come into conflict with each other, which conflict would result in (1) each company finding its operation under the trademark in question being restricted to the territory in which it actually operated prior to the entry thereinto of the other company, or (2) one company buying the rights of the other company at, usually, the seller's price.

Another common situation arises where two companies, which are operating under similar trademarks, commence operations with slightly different products and later one company decides to add to its line a product similar to that of the other company and wishes to do so under its existing trademark. This presents a similar case of conflicting rights with the same two difficult alternatives. This second situation is somewhat more difficult to prevent than the first, but its likelihood can be minimized by careful investigation of the trademark situation prior to embarking upon a a business venture. Even when a company is starting, as many do, on a limited budget, the relatively small sum ($25 to $100 in most cases) required for a good trademark search is inexpensive insurance to protect a trademark upon which many thousands of dollars will subsequently be spent in advertising and with respect to which the entire anticipated goodwill of the company may be identified.

ROBERT E. WOODHAMS, Patent and Trademark Law, Kalamazoo, Mich.

80 years until harvest time

Douglas fir forests, which supply raw material for most of Weyerhaeuser's mill sites, require 80 years to grow a seedling into a tree of mature size. Contrary to popular belief, only a small part of the total program of reforestation is accomplished by artificial planting and seeding. The primary reforestation job is the restocking of cut over land as old growth timber is harvested. This is being done by natural reforestation with seed supplied from blocks of trees reserved during logging and left standing to reseed the adjacent cut-over area. Where natural seed sources have failed, artificial reforestation by sowing tree seeds with helicopters or mechanical seeders is used.

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PULP DIVISION WEYERHAEUSER

An arbitrary mark is a trademark that has no meaning of its own with respect to the goods upon which it is being used and is dependent solely upon the use thereof for attaching such meaning. Examples are most trademarks involving a symbol or a design as well as those consisting of an arbitrary association of letters, such as "Kodak" as well as those derived from the initial letters of a company's name, as "Becco." A personal name mark is one in which the surname of the proprietor, or someone else connected with the business, is used as a trademark, such as "Ford," "Buick," or "Westinghouse." A geographic mark is one in which some name, which is primarily geographic, is used as a trademark such as the name of a city or the name of the state in which the particular product is made. Lastly, a descriptive mark is one in which the word chosen as a trademark has a primary meaning describing the characteristic, or a hoped for characteristic, of the product, such as "Butter-Krust" when used with bread.

Generally speaking, the legally strongest trademark in the long run will be an arbitrary trademark. However, since it carries no meaning or message of its own, but is dependent entirely upon advertising thereof to acquire a meaning, it is usually the most difficult and most expensive mark to develop. Nevertheless, when it is finally developed, it will carry the widest scope of protection and resist copying and approximating to the greatest degree because there is never any excuse for simulating a truly arbitrary mark except the desire to make use of its goodwill. On the other hand, descriptive, geographic, and personal name trademarks are much easier and less expensive to introduce to a given market because, as in the case of the descriptive trademark, they carry their own laudatory message or, as in the case of personal name and geographic trademarks, they carry their own indication of the origin of the goods. However, the identification of goods by such marks can never be as exclusive as it can be in the case of strictly arbitrary marks for the reason that, even though such a mark becomes well accepted as referring to a particular product, the word involved must always be admitted to have a separate primary meaning; and a competitor can always use such word in its primary meaning if it suits his purposes, providing he actually uses only the primary meaning. For example, the most that the company making Horlick's malted milk in Racine, Wis., could do to prevent confusion by another person by the name of Horlick who operated in Horlicksville, Wis. (about five miles from Racine) who wanted to sell dog food also under the name of "Horlick," was to require that the Horlicksville company should place upon its labels in type of readable size the legend "Manufactured by Charles Horlick, Horlicksville, Wis." instead of "Manufactured by Horlick, Horlicksville, Wis." The inadequacy of this solution from the standpoint of clarifying identity to the average customer is self-evident. (Horlick versus Horlick, C.C.A. 7—1944 143 F. (2) 32.)

WHAT IS IMPROPER SIMILARITY?

This is a subject about which entire books have been written. However, its principle may be stated in a relatively few words. Having in mind the particular trade involved, the particular type of customers expected, and the particular kind of goods sold, a trademark should not be so similar to another trademark as to enable one business entity to trade upon the goodwill of another business entity. The broad principle has called forth a number of secondary rules to assist in interpretation of specific cases.

One of the most important of these secondary rules is that the use of a trademark may be distinguished as well on the basis of the goods involved as upon the basis of the mark itself, or upon a combination of both. Thus, the use of a given trademark for perfume would under no conditions imaginable to the writer prevent the use of exactly the same trademark upon a machine tool, such as a lathe, for the goods are completely unrelated, are sold through different channels of commerce, and are sold to different consumers. However a trademark utilized for perfume would prevent the use of the identical mark, or even of a somewhat similar mark, upon a face powder or a perfume atomizer, for these are goods sold over the same counters to the same class of customers.

Next, it is important to remember that a trademark does not lose its similarity to another trademark merely by modifying the spelling. Thus, for trademark purposes the terms "High-grade," "Higrade," or "Hygrade," are all identical. The important consideration here is that the sound of each of the three renditions of the trademark is identical in each case so that where a product is requested over the counter, or radio advertising thereof is utilized, it is impossible to determine which mark is actually intended.

Further, following this same thought, the same rule has been applied to trademarks which actually involve different words but in which the sound is so similar that it is difficult on hearing the mark spoken to determine which of the two marks is intended. For example, "Dart" and "Dot" have been held to be improperly similar for use on somewhat similar goods, for even though the words involved are admittedly different words, they sound virtually identical with each other when spoken with an Eastern accent. Likewise, "Zip-Lac" and "Jap-A-Lac" have recently been held improperly similar when applied to similar goods.

A variant of this situation involves the use of foreign words where the foreign words are of fairly common understanding. This has been particularly important in many instances in the perfume field where, for example, the trademark "Premiere Nuit" has been held to be for trademark purposes identical with the words "The First Nighter."

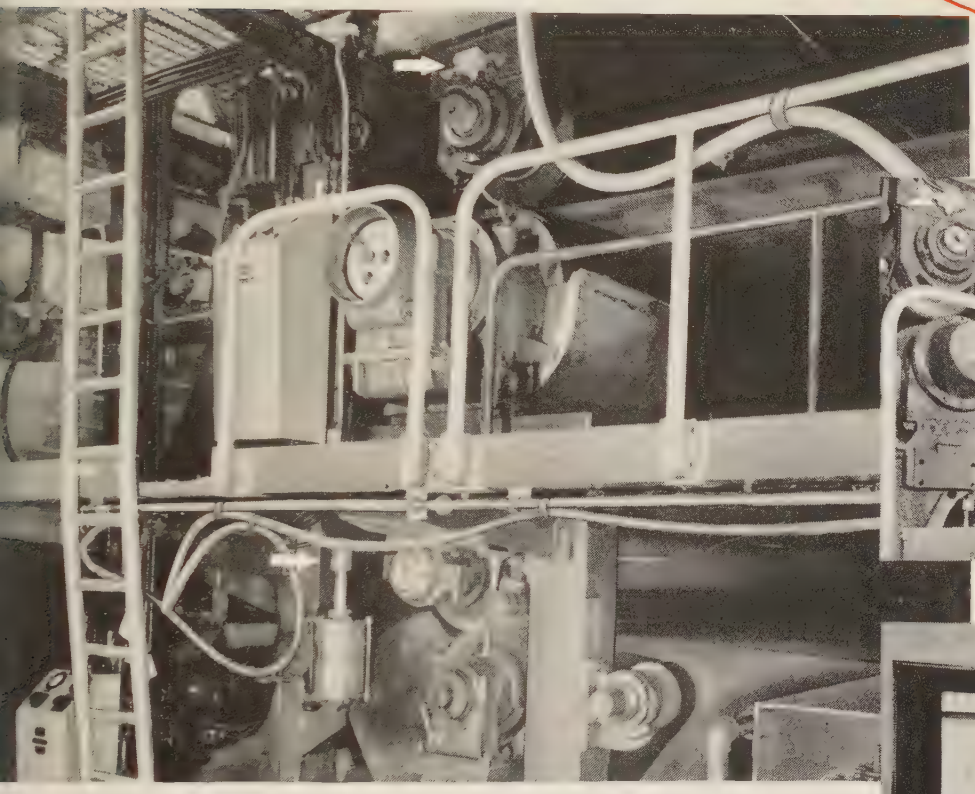
One of the most difficult types of trademark similarity to foresee, and yet nevertheless necessary in choosing a strong trademark, is the situation involving a mark having a similar *meaning* to that of another mark even though both the appearance and the sound of the two words differ. For example, "Robber" and "Brigand" have been held to be similar words for trademark purposes, as have also "Elf" and "Pixie."

REGISTRATION

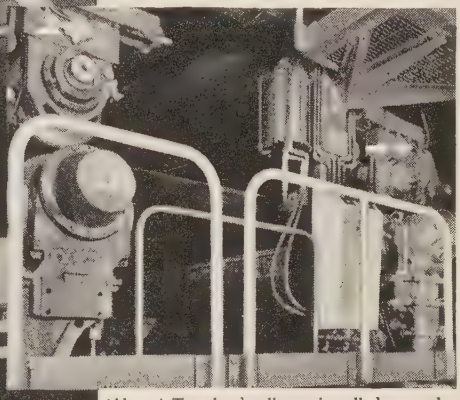
While there are a number of incidental rights and benefits arising from trademark registrations, the primary purpose thereof is to place one's mark upon a national register in order that other persons interested in that mark for use on a particular type of goods may be enabled to learn of the first user's use thereof before

THE KEY TO ACCURATE CONTROLLING AND RECORDING OF ROLL PRESSURES

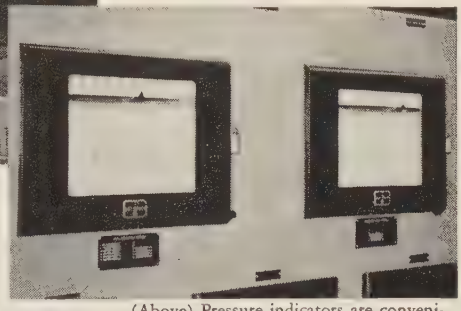
Downingtown Load Meters



(Left) Close up view of a Downingtown Suction Drum Press with load cells indicated by arrows. Cells are mounted between top arm and bearing housings. Similar cells are installed on back bearings. Lower Suction Extractor has load cell connected in air cylinder rod.



(Above) Two load cells are installed on each of the rolls indicated by arrows. Identical cells are used on the back bearings.



(Above) Pressure indicators are conveniently located near control panels but can be placed anywhere in the building. Provision can be made to accommodate future load cell installations.

More and more paper and board manufacturers are turning to Downingtown Load Meters for indicating, recording or automatic control of pressure and tension. While the installation shown here consists of Load Meters, on a paper machine wet end, they are being used to control pressure wherever it exists between two rolls and also to indicate fibre tension. They may also be used to record felt tension and other applications where loading and tension are factors. In the particular section illustrated here, twenty-six load cells are used.

The advantages of automatically indicating, controlling and recording roll pressures are fairly obvious. But the great advantage of using Downingtown Load Meters is in their simplicity of operation and installation . . . their freedom of influence from mechanical maladjustments, temperature and moisture . . . and their flexibility which allows installations to meet any variety of mill conditions.

A Downingtown bulletin is available which describes the Load Meter and its operation in detail. Write for it or consult your Downingtown Sales Representative.

DOWNINGTOWN MANUFACTURING CO.
DOWNINGTOWN, PA.

West Coast Representative:
John V. Roslund, Pacific Building
Portland 4, Oregon

DOWNINGTOWN
LOAD METERS
MODERNIZATION IS PROFITABLE

DESIGNERS AND BUILDERS OF PAPER, BOARD AND FELT MACHINES SINCE 1880

themselves entering upon the use of the mark and thus generating a situation of conflict. While rights to a trademark, apart from the right to register same, are actually created, as above stated, by use thereof and are limited to the goods and to the area for which and over which used, the interpretation of those rights will usually be materially affected by whether or not one has registered his mark and has thereby given others an opportunity to find out about the use of it. The present trademark statute provides that registration of a trademark provides constructive notice of its existence and use throughout the United States and this question of notice has a strong effect upon a court in deciding conflicts between companies having otherwise equal rights. Nevertheless, it will bear reiteration that the origin of trademark rights is in the *actual use* of a trademark, and registration only affects the interpretation thereof.

The registration procedure is relatively simple. It involves the filing of an application showing the mark as used, the presentation of five specimens of the marks as actually used upon the goods themselves (or photographs thereof if actual specimens are not feasible) and a statement of the nature of the goods upon which the mark is used and the date of first use. The application is subjected to examination. This means that an examiner in the trademark division of the Patent Office reviews prior United States registrations to determine if there are any of conflicting nature, i.e., of similar names for similar goods regardless of the territorial extent of their use. If there are, the application is rejected. The applicant is, however, as in the corresponding situation involving patents, given an opportunity to point out why the prior registrations should not be set up as barriers to his desired registration and the argument will receive the careful consideration of the examiner in charge. In fact, most applications that eventually mature into registered trademarks are rejected once or twice during the course of their processing.

When the Patent Office Examiner is satisfied that the trademark may properly be registered, he causes it to be published in the Official Gazette of the Patent Office. For 30 days after the date of such application, any person who feels he would be damaged by the registration of such trademark has an opportunity to file a notice in the Patent Office that he wishes to oppose the registration of the mark. A hearing, including briefs by both parties, is then held to determine whether the opposer's reasons for his opposition are valid. Such a hearing usually involves a determination of whether the mark sought to be registered is confusingly similar to a mark which the opposer is already using, having in mind, as above discussed, (1) the similarity of the marks themselves, (2) the goods upon which used, and (3) the kind of trade in which used. The final registration is then granted or denied upon the basis of the outcome of the opposition hearing.

Trademark rights may be maintained indefinitely, provided the mark is used continuously or, if use is discontinued, such discontinuance is only temporary. The courts are extremely liberal in finding that a business organization discontinued use of the mark without intent to abandon same. For example, many trademarks which were used with intoxicating liquors were necessarily discontinued during Prohibition but, when the companies resumed operations after the repeal of Prohibition, these trademarks were generally protected upon the grounds that there was never any intent to abandon same. The same situation was true during World War II when many products were temporarily discontinued due to materials or labor shortages.

A registration is effective for 20 yr. and may be renewed for subsequent 20-yr. periods for as long as the mark is in actual use. However, under the 1946 Trademark Act, an affidavit must be filed 5 yr. after the date of registration to the effect that the trademark so registered is still in use, if it is, or otherwise the trademark will automatically be removed from the Register. This is for the obvious purpose of promptly removing from the Register many hundreds of marks which are registered for businesses or products which become inactive within a few months or years in order to make these or similar marks available to others if desired.

If the foregoing points are kept in mind by the industrial manager who sets up a new business enterprise, or chooses a trademark for a new product of an established business, the task of the trademark lawyer who may later come into the picture will be made much easier and the cost of properly securing the trademark for the exclusive use of this enterprise will be held to a minimum. Further, a basic understanding of trademark practice by the industrial manager will assist him greatly in working with the trademark lawyer, which will be to their mutual benefit and to the further benefit of the company whom they both serve.

TAYLOR-STILES RAG CUTTERS ARE STANDARD EQUIPMENT

in roofing paper, strawboard and fine paper mills, because they are designed and constructed specifically for constant heavy duty in paper making.

TAYLOR-STILES MULTIPLEX CUTTERS

are used wherever rags must be cut into extremely small pieces in a single cutting operation.

Send for folder APP 203 for description of cutters used by the paper industry.

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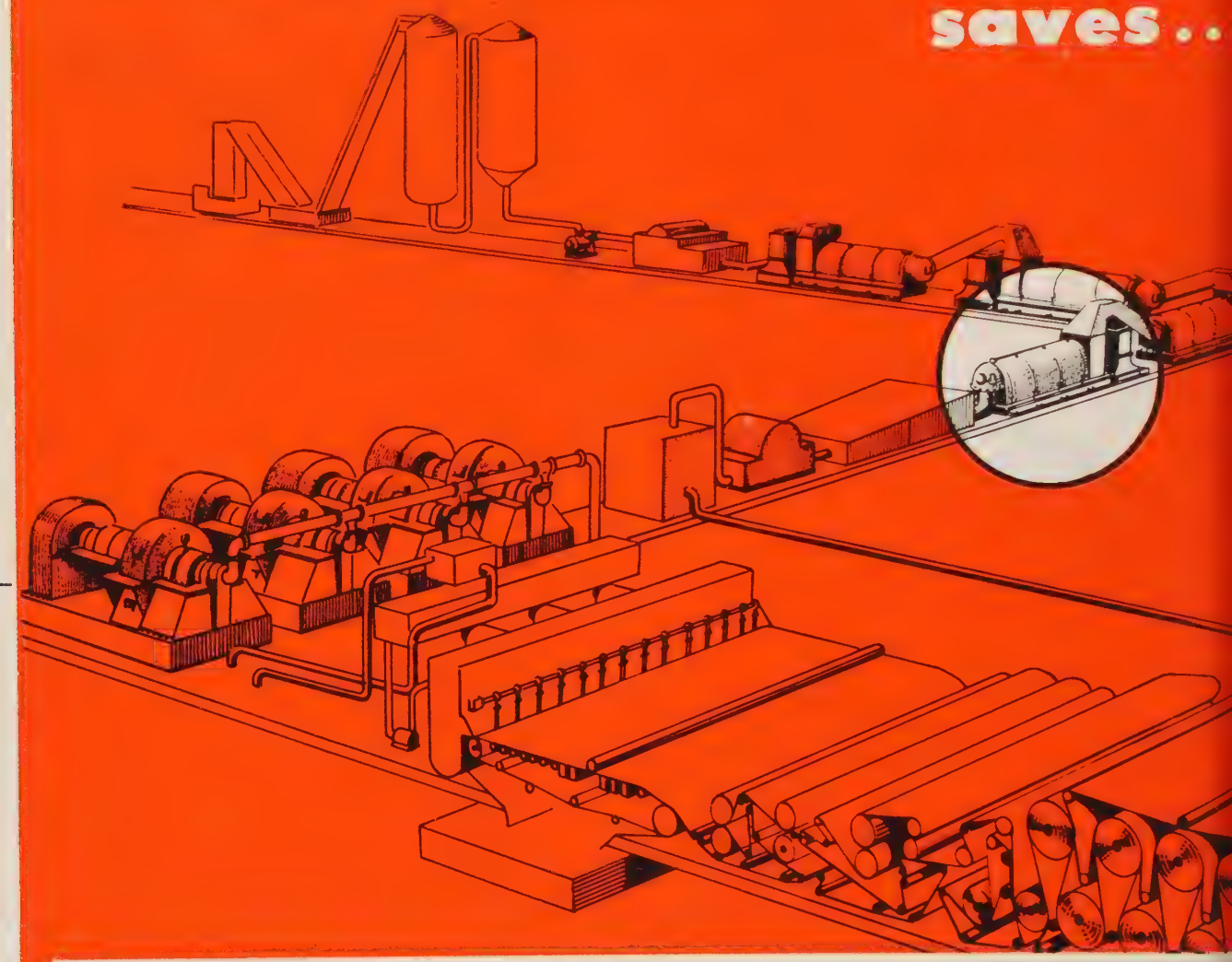
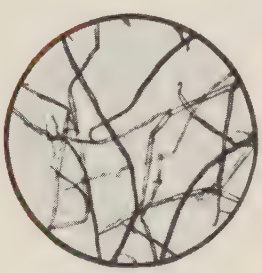
City.....*State*.....

a LONG stride forward.

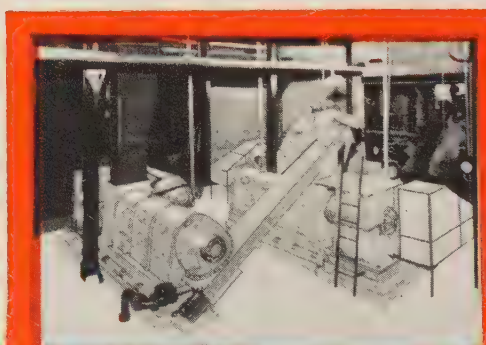
saves..



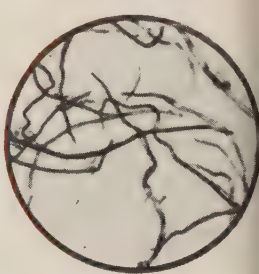
Photomicrograph of diffuser washed kraft pulp.



Press units installed in leading southern kraft mill.



Photomicrograph of pre
sure washed kraft pul
Note curling of fibers.



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chemicals, heat, water, power, space...

increases operating efficiency

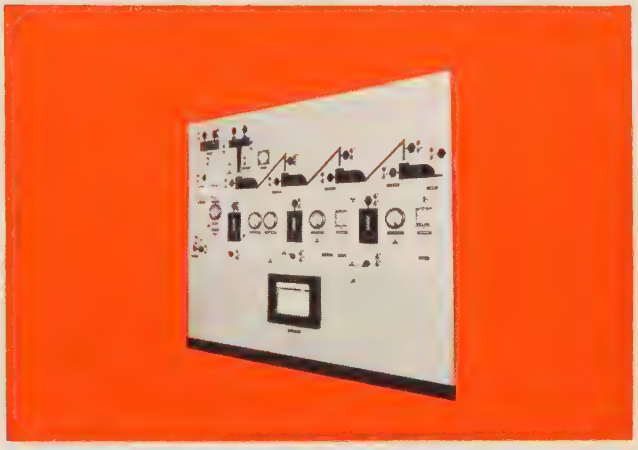
Based on a counter-current principle of washing in a series of specially designed presses, the *Sutherland Pressure Washing System* represents a real advance over other washing systems . . . real profit to the mill owner.

OPERATION

Pulp is pumped from a conventional blow tank at 3-5% moisture free consistency and thickened to twelve percent in an underpass thickener. Fed into the presses, it is alternately squeezed to about 36 to 38 percent dry and then diluted about 12 to 14 percent with liquor from the succeeding press. The strong liquor draining from the thickener is sent to the evaporators of the recovery system.

THE RESULTS:

1. *Water Consumption:* for a 300-ton system less than 200 g.p.m.
2. *Heat:* since pressure is used instead of vacuum, better blow-heat recovery results . . . evaporators get the black liquor at higher temperatures . . . no flashing of steam because of absence of vacuum.
3. *Power Requirements:* only 1.71 horsepower per air-dry ton for a four stage system.
4. *Chemical Recovery:* positive squeezing action insures uniform separation of liquor from pulp, higher yield. Even true knots lose much liquor in the operation.
5. *Pulp Quality:* intense rubbing action and pressure contribute to strength development of pulp. Positive curling of the fiber is a characteristic of pressure washed pulp.
6. *Space:* considerable space saving results from fact that presses are of compact design and may be arranged in a variety of ways to suit requirements of the individual mill. High consistencies and foam free operation obtained from system means that over-size transfer and settling tanks are not necessary.
7. *Control:* entire system is operated from a *single* panelboard, permitting easy adjustment of output to mill requirements.



Single Panel provides complete control of process for one operator. Audio and visual alarms signal operator instantly in the event of trouble.

THE ADVANTAGES OF SUTHERLAND PRESSURE WASHING SYSTEMS ARE BEING DEMONSTRATED EVERY DAY IN ACTUAL MILL OPERATION.

SUTHERLAND PRESSURE WASHING SYSTEMS CAN BE FURNISHED IN FOUR AND FIVE STAGES TO FIT THE NEEDS OF THE INDIVIDUAL MILL . . . AT A CAPITAL INVESTMENT APPRECIABLY BELOW THAT OF CONVENTIONAL SYSTEMS.

For more information, write for a copy of "PRESSURE WASHING" which presents a case history of actual mill experience.

PRESSURE WASHING

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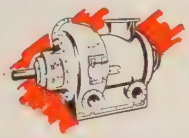
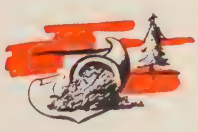


BREAKER TRAPS



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TAPPI Nonfibrous Raw Materials Report—1952

E. N. POOR

Pulp and paper production continued at an overall high rate during 1952 although reports from the first 9 months indicated some reduction in some parts of the industry.

The demand for chemicals was strong, some vital raw materials being in short supply early in the year but attaining balance during the year.

A summary of information on several important raw materials is given below:

SULPHUR

Availability. At the beginning of the year sulphur was in short supply. Consumption of sulphur in the United States was limited by the government (NPA Order M-69) to 90% of 1950 use plus special allowances for defense and essential civilian requirements. Consumer inventories were limited to a 25-day supply. During the first half of the year the situation improved and by July supply and demand were virtually in balance. The consumer inventory limitation was raised on August 19 from 25 to 60 days. NPA removed all controls on sulphur use in the United States effective Nov. 5 and all inventory controls Nov. 7, explaining that sulphur supply had caught up with demand. Controls on price and exports overseas, however, remained in effect. For the full year 1952, government estimates place United States supply (production plus imports) at 6,524,000 long tons and consumption (including exports) at 6,090,000 long tons.

New Uses. There were no significant new uses reported for sulphur during the year.

Price Changes. The domestic prices of the major producers remained unchanged.

Substitutes. There were no new substitutes reported for sulphur.

Outlook for 1953. Numerous projects to increase the supply of sulphur are expected to be completed during 1953. The increase in supply is expected, however, to be offset by an increase in demand. Government estimates for 1953 place United States supply (production plus imports) at 7,000,000 long tons and consumption (including exports) at 6,637,000 long tons.

CAUSTIC SODA

Caustic soda will be generally available during 1953 with no shortages contemplated except as may arise locally from strikes. In such cases, it would be only temporary local shortages since the rest of the industry can probably take up the slack. There is no significant change in price anticipated.

LIME

Availability. There has been during 1952 a plentiful supply of lime for all users in the chemical and paper mill field, and the new paper mills and plants that expect to get under operation early in 1953 will have no difficulty in getting the lime that they may require.

New Uses. No outstanding new uses for lime are known. It is still the cheapest and best alkali that is obtainable.

Price Changes. There has been considerable change in the freight rates on lime during 1952 that resulted in an increase in the cost to the consumer, but the lime manufacturer has not received any increase in his mill price in 1952.

Outlook for 1953. The outlook for 1953 is very uncertain as to price due to the steady increase in the cost of manufacturing.

Unless something develops that puts an abnormal demand upon the manufacturers who consume lime there will be plenty of lime available in 1953.

The tendency among carload users of quick lime is to equip their plant to receive lime in covered hopper cars. Lime manufacturers as a whole feel that this is a move in the right direction as the lime is not only delivered to the ultimate consumer in better condition, but it eliminates the constant complaint of lime-burns and air-slacking.

It is suggested that all consumers who now receive their chemical lime in hopper cars, permit the supplier to load to full capacity as there is not a surplus of this type of railroad equipment.

SODIUM SILICATE

Sodium silicate consumption continues to increase with groundwood bleaching. Supply is adequate and prices are firm.

CHLORINE

Availability. The chlorine shortage did not continue after March 1, 1952, and chlorine has been readily available since that time. Increasing production facilities and a lessened demand provided this condition.

New Uses. There are no outstanding new uses.

Substitutes. There is no substitute in any quantity. During 1952 one small pulp mill installed a plant to produce chlorine dioxide gas as the bleaching agent.

Outlook for 1953. The chlorine producing capacity has been greatly increased in 1952 and together with that building for operation in 1953, the supply should be ample in 1953.

SULPHUR DIOXIDE

Availability. The situation on elemental sulphur has improved considerably during the year and although it is still under NPA regulations, the international supply has so greatly improved that in all probability it will be completely removed from allocation before the end of the year.

Price Changes. There have been no price changes in 1952. However, if the general price level of elemental

E. N. Poor, Chairman, TAPPI Nonfibrous Raw Materials Committee; Chemist, Kennebec Div., Hudson Pulp & Paper Corp., Augusta, Me.

whys ?

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CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

sulphur is raised, sulphur dioxide prices will also have to be adjusted.

New Uses. New applications continue to develop for sulphur dioxide. The two newest and most principal developments are the use of sulphur dioxide as a grass silage preservative and its use in the glass industry. Other applications are pending and others are held in industrial confidence.

Substitutes. Again we must report that no substitute has been developed for sulphur dioxide. It appears quite impractical that one will ever be developed since this is a basic inorganic chemical. It is like trying to develop a substitute for sulphuric, hydrochloric, or nitric acids.

Outlook for 1953. The short range outlook for sulphur dioxide as was indicated under availability has improved remarkably during the year, principally due to a cutback in industry demand and an increase in production of elemental sulphur both in this country and in Mexico. Of course, a major scale war could completely change the picture, but short of this the situation appears optimistic.

PEROXIDES

Availability. The consumption and availability of hydrogen peroxide and sodium peroxide are increasing with growing demands.

New Uses. Peroxide applications in the pulp and paper industry are expanding in the following processes: (1) bleaching groundwood, (2) bleaching mixtures of groundwood and sulphite pulp, and (3) recovery of waste papers.

Peroxide bleaching of chemical and semichemical pulps is showing favorable trends in laboratory studies, mill trials, and in limited commercial operations.

Price Changes. The market prices for hydrogen peroxide and sodium peroxide are expected to remain reasonably stable.

Substitutes. Hydrosulphites and hypochlorites are being used for some special applications in the bleaching of groundwood, e.g., hydrosulphite for bleaching West Coast woods and hypochlorite for bleaching hardwoods.

Use of chlorine dioxide, sodium chlorate, and sodium chlorite is expanding in multistage processes for bleaching chemical pulps.

Outlook for 1953. Large expansions in peroxide production are scheduled for completion in 1953 to meet the increasing demands for these chemicals, particularly in the pulp and paper industry.

ANIMAL GLUES

Availability. Since mid-year there has been a gradual increase in the demand for animal glue and it is evident that with any further improvement in business, there will be a shortage of some grades. Although inventories of lower grades are adequate, supplies of intermediate and higher grades of glue are short and close to the all-time low.

Some improvement in production is anticipated as raw materials for making animal glues are in much better supply than earlier in the year and the major part of the industry operating on a 5-day basis, should soon be able to start 6-day production. It is expected, through increased production, the industry should be able to satisfy demands for all grades but consumers are cautioned to carry reasonable working inventories to allow for delayed deliveries.

Price Changes. Although prices for animal glues have not changed for the past year, the industry has been faced with higher labor, coal, and freight costs which have so far been absorbed, but it is apparent that further increases in costs might necessitate higher selling prices.

Outlook for 1953. Conditions indicate the industry will operate at capacity during the forepart of 1953 and enough animal glue should be available to satisfy demand. If there should be an unusual business spurt, a shortage could exist in all but the lower grades as inventories of higher grades are low and could not be increased even with greater production.

CASEIN

Availability. On Dec. 30, 1952, the United States Government removed all import quota and license restrictions on casein. At the same time restrictions were imposed on dried whole milk, dried buttermilk, and dried cream. These combined actions clear the way for the unlimited importation of foreign casein and automatically tend to act as a further retardent of domestic production.

The quota as fixed by the United States Department of Agriculture for the fiscal year to end June 30, 1953, was 46,000,000 lb. United States consumption at present is estimated to be 60,000,000 lb. annually. If the quota restrictions had not been lifted a critical shortage would have arisen inasmuch as domestic production continues nil in view of government subsidies on most other milk products. Between only 2 and 3,000,000 lb. of domestic caseins are available from stock, certainly insufficient to compensate for a possible 14,000,000 lb. needed but not available under the quota system.

With consumers having purchased as heavily as possible whenever licenses were made available, there was bound to be some letup in consumer buying when casein was freed of import controls. This was evidenced by the fact that for several weeks after December 30, there was some inactivity on the part of buyers. While the Argentine market went unchanged, certain spot or nearby positions were quoted lower, particularly parcels to arrive via Europe, or so-called switch transactions.

Despite large stocks in Argentina, probably between 18 and 20,000 metric tons, and the instance of heavy production during their present flush season, the modest market there may not hold if buying freshens appreciably here. It must be recognized that European production is very low during this season of the year and Argentina is in a position to do a considerable volume of business on more or less her own terms. In very recent years, France has again become a major factor in casein production and Argentina will heed this, having learned a lesson during the 50–51 and 52 seasons, when France averaged some 15,000,000 lb. during the three periods.

Estimates at this time indicate an Argentine production of perhaps 25,000 tons for the 52–53 season. It will be a great surprise if the United States produces as much as last year in view of the anticipated huge production of nonfat solids milk powder. The pro-

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My Jordan plug is badly worn. Does this mean a new one?

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But one of our sales engineers will examine it right away . . . What he will most likely recommend is an EMERSON STAINLESS STEEL JACKET . . .

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nless End Plate Rings are used to give protection
n corrosion to all exposed surfaces. Different sizes
nives can be used without change in the plug body.

Call our Representative for details . . .

John W. BOLTON & Sons, Inc.

EMERSON MANUFACTURING DIVISION

Lawrence, Massachusetts, U.S.A.

duction of nonfat powder during 1952 will have likely equaled 800 million lb.

On the future of government support programs rests domestic production. The general consensus is that the supports will continue.

STARCH

Starch was readily available in 1952. Prices were slightly higher than 1951. The outlook for 1953 is good with stable prices.

ENZYMES

There have been no important changes in starch converting enzymes during the past year. Prices remain the same and the supply is ample to meet all normal demands.

ZINC SULPHIDE PIGMENTS

Although the high rate of business activity anticipated for 1953 will result in continued large demands for zinc pigments from a wide variety of consuming industries, there will be sufficient supplies available.

Zinc sulphide, the zinc pigment of highest opacity, is for the special applications in the paper industry where high opacity and nonyellowing characteristic are indicated, as in laminated paper-plastic boards. The current price of the pigment is 25.30¢ per lb., carloads.

The increased use of lithopone in latex paints suggests the idea that it might also find greater application in paper coatings of latex and other types. This pigment is now in free supply and should continue to be available in sufficient quantities to meet the tonnage needs of the paper industry. Current price is 7.50¢ a lb., carloads.

Titanated lithopone is expected to continue in good supply to meet the paper industry's needs for a white pigment intermediate in opacity between lithopone and zinc sulphide. Current price is 10.00¢ a lb., carloads.

Fine particle size zinc oxide, widely used as an activator and reinforcing agent in rubber, is finding a new use in the paper industry. It serves as curing agent for certain elastomers that improve the wet strength of paper. This zinc oxide is available at 14.25¢ a lb., carloads.

TITANIUM PIGMENTS

Availability. Titanium pigments have been available without any restrictions during 1952, and with increased facilities that were brought in in the latter part of 1951 and the early part of 1952, no reason is seen why they should not remain in ample supply for 1953.

New Uses. Uses for titanium pigments continue to be essentially in the beater additions and coating applications and are extending in these fields.

Price Changes. At this time, there are no price changes contemplated.

ALUM

Commercial. Although the demand for commercial alum in 1952 was heavy, the expected shortage did not materialize, therefore supply and demand were well in balance. It is expected that this situation will prevail in 1953. The price, quality, and uses of the product have not varied significantly, but should the price of sulphur increase, as there is a possibility, the price of alum will undoubtedly follow suit.

Iron Free. Supply and demand of iron free alum were well in balance during the year 1952 and are expected to continue in 1953. The material is being used in fair quantity for the production of Napalm. The availability of it during 1953 may depend to a considerable extent on the war activity and its result on the demands for Napalm. There have been no price changes; however, the price may advance with any price increases of sulphur.

CLAY

Availability. Supplies of American papermaking clays continue adequate for all needs. Production of higher grade printing and publication papers is still on the increase, but clay-industry capacity is well able to keep pace with demand.

Price Changes. There have been no changes in price of any standard American grades of papermaking clays. The rising trend of freight rates for both domestic and imported clays continues unabated.

New Uses. Increased interest in the use of clay in the lowest printing grades has been noted in many quarters. It is difficult to say how much of this interest has progressed to the production stage. No other new uses have been noted, nor has any practical substitute material made its appearance.

Outlook for 1953. Clay consumers may go into 1953 with the utmost confidence in the ability of the American industry to meet all requirements both quantity and quality-wise.

DYESTUFFS

Availability. The year 1952 was occasioned by a free supply of all dyes during the first nine months of the year. However, during the last quarter there was a considerable increase in demand for all dyes causing isolated shortages while the manufacturers realigned their schedules. In general the temporary shortages did not seriously affect the paper industry.

New Uses. There were no major new uses for dyes developed during the year. The relatively new "white" dyes were further gained in favor and were used in a wide variety of white papers to improve whiteness.

Price Changes. There were no significant price changes during the year. The outlook for 1953 is favorable and at present the indications are no shortages are anticipated and all dyes should be readily available.

PETROLEUM WAX

Availability. Increased stocks of fully refined paraffin wax were reported in view of entry of new wax refiners in the domestic market. Inventories remained high during first half of 1952 with a drop-off during the latter half. Microcrystalline wax inventories relatively high during first quarter of year, however, had dropped to a new low at close of year and may lead to a shortage. This has been brought about by the curtailment of the lubricating oil market because of the build-up of foreign refining capacity.

Price Change. Refined paraffin prices were stable through 1952 following price reduction on high melting point fully refined paraffins. Price of scale wax was

A Progress Report on the Status of FluoSolids

Applications of Non-Catalytic Fluid Techniques Expanding into Many New Fields

oneered by Standard Oil De-elopment Company during orld War II, fluidization is to-y widely recognized as an ideal eans of promoting intimate con-ct between solids and gases. As ensee in all non-catalytic non-drocarbon fields, The Dorr Com-ny has continually expanded e applications of this new tech-que since 1944. At the present me, FluoSolids is demonstrating tstanding advantages in the ocessing of a wide variety of etallic and non-metallic miner-s, and holds great promise for e future in other fields not yet lly developed.

OLD

ne of the first applications of the orrco FluoSolids System was e roasting of arsenopyrite gold es prior to cyanidation, and veral installations have been op-ating with marked success for o to five years. Latest develop-ent for gold roasting is the split mpartment Reactor. In this pe of unit, preliminary reduc-g conditions are provided in one lf of the Reactor and a com-ete oxidizing roast in the other, sulting in decreased cyanide nsumption and better metal-rgy at the mill.

YRITE

ne sulfur shortage has con-buted to great activity in the lp and paper field. Eight Fluo-lids Systems in the U. S., Canada and Norway are either in operation or under construction in sulfite pulp mills, for the production of SO_2 for cooking liquor. Eight more are in operation or being installed to produce SO_2 from pyrite, pyrrhotite and low grade sulfur ores at acid plants, which will produce over 1200 tons per day of H_2SO_4 by the contact method. This impressive record results directly from the fact that FluoSolids can deliver a high strength SO_2 gas at lower investment and operating costs than conventional roasters and provides users with an economically feasible and reliable source of SO_2 despite fluctuations in natural sulfur supply.

ZINC

The first commercial FluoSolids installation for the roasting of zinc concentrate went into operation in the summer of 1952. It is producing SO_2 gas for sulfuric acid manufacture and a desulfurized zinc calcine for leaching, prior to electrolytic zinc production. Results to date have demonstrated marked simplicity of control and operation, and two other zinc producers have ordered similar Systems.

COPPER

More recently, the first FluoSolids System to provide a sulfating roast to a copper-zinc concentrate went into operation. In this application, close operating controls make it possible to render the valuable base metals soluble and, at the same time, minimize solubility of the iron. This permits high recoveries of copper and zinc by leaching. When followed by electrolytic precipitation, economic advantages are indicated under many conditions as compared with conventional smelting practice.

NEW DEVELOPMENTS

Studies to explore the utilization of FluoSolids for the beneficiation of low grade iron ore are now being conducted. In this operation, hematite is given a reducing roast to convert it to magnetite for subsequent concentration by wet magnetic means. Higher unit recovery of iron and the production of better concentrate grades indicates improved economics as compared with other beneficiation methods.

Among the other numerous fields currently under investigation are the calcination of alumina, the reburning of precipitated lime sludge and the self roasting of low grade sulfur ores.

If you would like more information on FluoSolids — the most significant advance in roasting technique in the last 30 years — write The Dorr Company, Stamford, Conn. or in Canada, The Dorr Company, 26 St. Clair Avenue East, Toronto 5.

FluoSolids is a trademark of The Dorr Company, Reg. U. S. Pat. Off.

The DRAPER Felt
DRAPER BROTHERS COMPANY
CANTON, MASS.

further weakened by loss of foreign market, but remained relatively stable through latter half of 1952.

New Uses. The use of polyethylene has increased by its introduction into most forms of wax coatings. Microcrystalline wax was used in increasing amounts in coating for bread and frozen food wrap. Demand for laminating microcrystalline waxes continued high and in many cases tackifiers were employed to improve the bond.

No cheap substitutes are available.

Outlook for 1953. Prices existing in last quarter of 1952 for paraffin wax and scale wax should hold stable throughout the year. What effect cut-back in solvent oil production will have on supply remains to be seen. Microcrystalline wax inventories will remain low through at least first half of year.

WAX SIZES

The availability of wax sizes in 1952 was excellent with no new uses being reported.

The price was decreased by 15% and it is expected that it will remain firm in 1953 with ample supplies for the industry.

SODIUM ALUMINATE

Availability. Although the demand for the papermakers' grade of sodium aluminate more than doubled this year, production kept pace and at no time was there a shortage or a threatened shortage.

New Uses. Considerable interest has been shown in its use in coating formulations. This has not developed to a point where it can be considered as a new use.

Price Changes. No increase in price is anticipated. Last increase was in January, 1951.

Substitutes. In view of the ready availability of sodium aluminate and the recently increased production facilities no substitutes are necessary or have been considered.

Outlook for 1953. The expected increase in demand for sodium aluminate in 1953 has been adequately planned for, and no difficulty in supply is anticipated. The paper industry can also expect improvement in quality of sodium aluminate.

BACTERICIDES

Availability. All the products generally employed for microorganism control such as the various mercurials, chlorophenates, and chlorine were, in general, readily available throughout the year. Chlorine, which was in short supply in some areas during the first part of the year, was generally available by mid-year, and no shortage currently exists.

New Uses. There have been no established new uses during the year. There has been some activity of combining toxicant with detergent for felt cleaning. This activity was not originated during the year, nor has the use become generally established.

Price Changes. Prices have been steady during the year, with neither general increases nor decreases.

Substitutes have not been necessary.

Outlook for 1953. The outlook for 1953 is for adequate supplies of all products at or near the current price levels.

PLASTICIZERS

At this writing supplies of the various softening agents appear to be in comfortable balance with demand and it is expected that this favorable situation will continue well into 1953 barring unforeseen developments.

Pricewise, the most interesting development of 1952 was the substantial decline in glycerin costs to consumers. All other chemical plasticizers remained unchanged. Invert sugar and corn sugar and sirup advanced moderately during the year with a slight decline in invert sugar looked forward to early in 1953. The price future for corn remains somewhat uncertain at this time.

CONTRIBUTORS TO REPORT

Glue—R. Tutt, Jr., Vice-Chairman, Peter Cooper Corp.
Caustic soda—R. L. Carr, Mathieson Chemical Corp.
Soda ash—John Schuber, Solvay Div., Allied Chemical & Dye Corp.
Sulphur—J. C. Carrington, Freeport Sulphur Co.
Sulphur dioxide—W. F. Luckenbach, Virginia Smelting Co.
Lime—W. F. Swan, Standard Lime & Stone Co.
Chlorine—R. W. Hooker, The Chlorine Institute
Peroxides—J. S. Reichert, E. I. Du Pont de Nemours & Co.
Alum—J. P. Bainbridge, Monsanto Chemical Co.
Sodium aluminate—H. E. Berg, National Aluminate Corp.
Starch—J. P. Strasser, Morningstar Nicol, Inc.
Enzymes—F. H. Denham, R. T. Vanderbilt Co.
Casein—J. Brown, Tupman Thurlow Co.
Dyestuffs—C. F. Schaumann, E. I. Du Pont de Nemours & Co.
Clay—J. H. Compton, Jr., Georgia Kaolin Co.
Zinc sulphide—R. Davison, New Jersey Zinc Co.
Titanium—H. L. Jungmann, Titanium Pigment Corp.
Wax—D. T. Jones, Atlantic Refining Co.
Wax sizes—W. B. Morehouse, Nopco Chemical Co.
Plasticizers—N. R. Pike, The Nulomoline Co.
Bactericides—W. D. Stitt, Buckman Laboratories, Inc.

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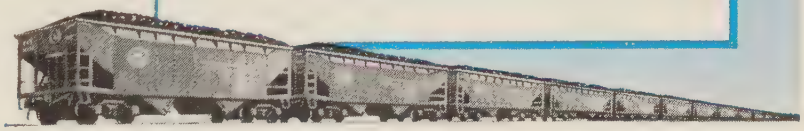

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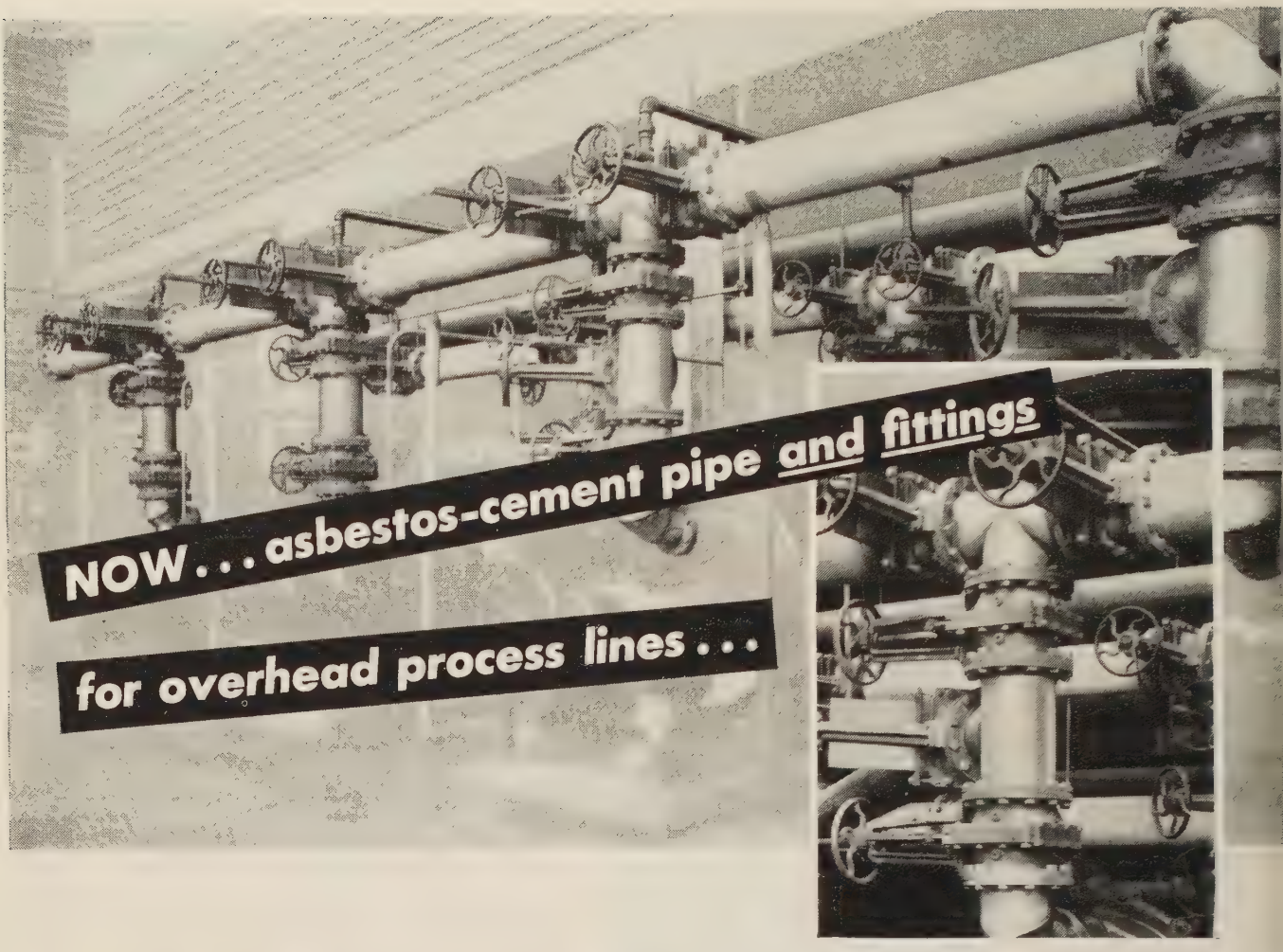

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You can now obtain Transite* asbestos-cement Pressure Pipe with Transite-lined Streed Fittings for your overhead process systems. This permits the installation of high strength non-metallic pipe for handling raw and treated water, washed and unwashed pulps, stocks of all kinds, multi-stage bleaching systems (except direct chlorination) and certain mill wastes. There is no better way to provide clean pulp and stock than by handling it through Transite Pressure Pipe.

Low installation costs—Transite is light in weight, easy to handle, and can be drilled, cut, threaded and machined with standard tools. *And*, because its carrying capacity stays high, you can specify the smallest diameter pipe necessary . . . thus making the minimum capital investment.

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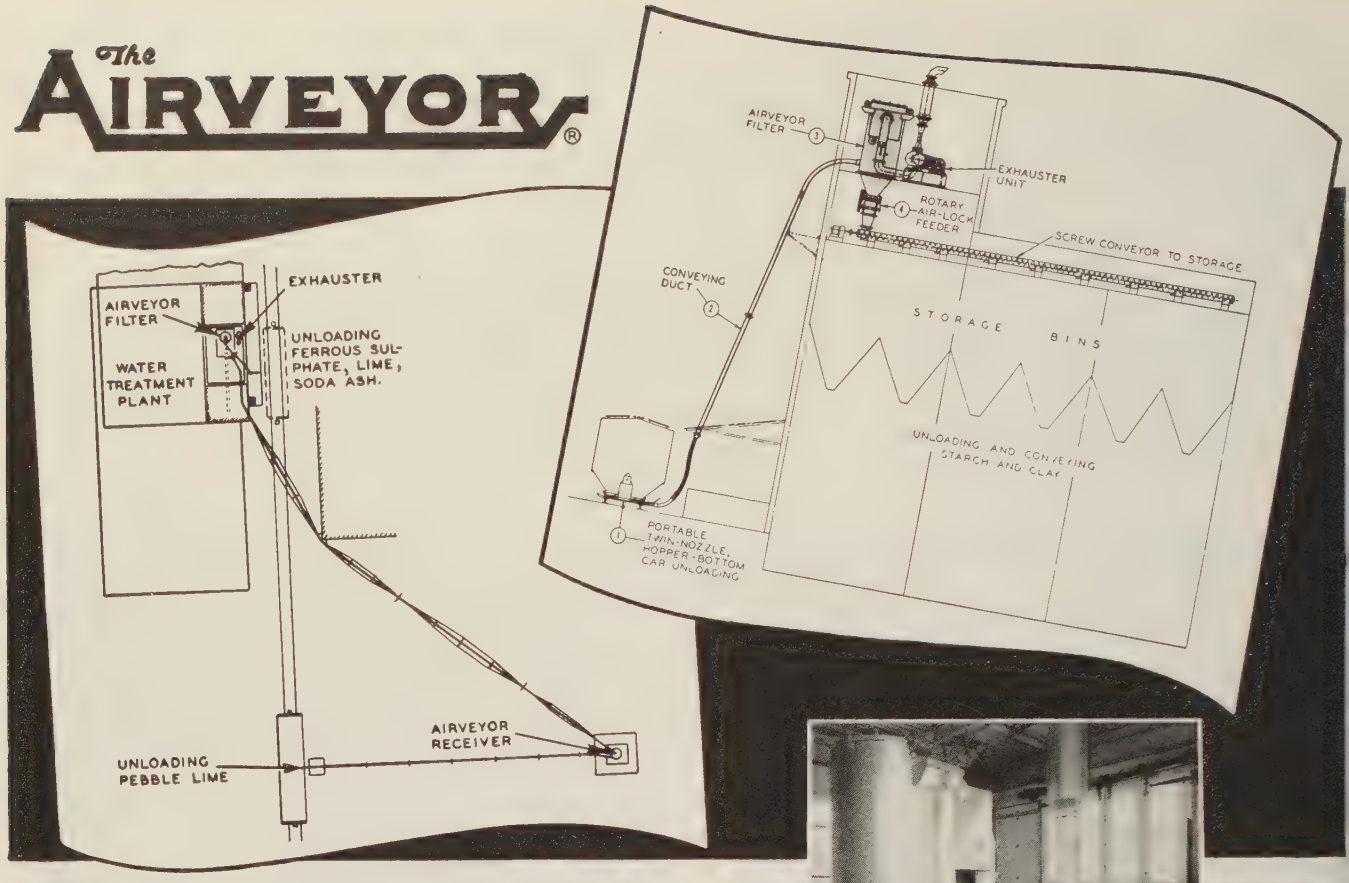

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When you handle dry pulverized and granular materials, the sensible, economical, and most satisfactory plan of selecting a pneumatic conveying system is to "Start from scratch" . . . make your selection while the plant is still in the planning stage. Pneumatic conveyors permit economy and convenience in location of buildings and production equipment without the restrictions or straight-line limitations of mechanical conveyors.

Fuller Engineers have years of experience in their field. They'll survey your plans, make a close study of local conditions and the materials to be handled. Then—they'll make their recommendation from one of the four Fuller time-and service-proved systems, at no obligation to you.

And—because each installation has peculiar requirements of its own—their recommendation will be the right one for the job—the system that will handle your materials in the most efficient and economical way. Shown here is the Airveyor, used successfully for unloading dry pulverized, crushed, granular materials from shipping units, and for conveying to and from storage. It is economical, safe, thoroughly dependable.

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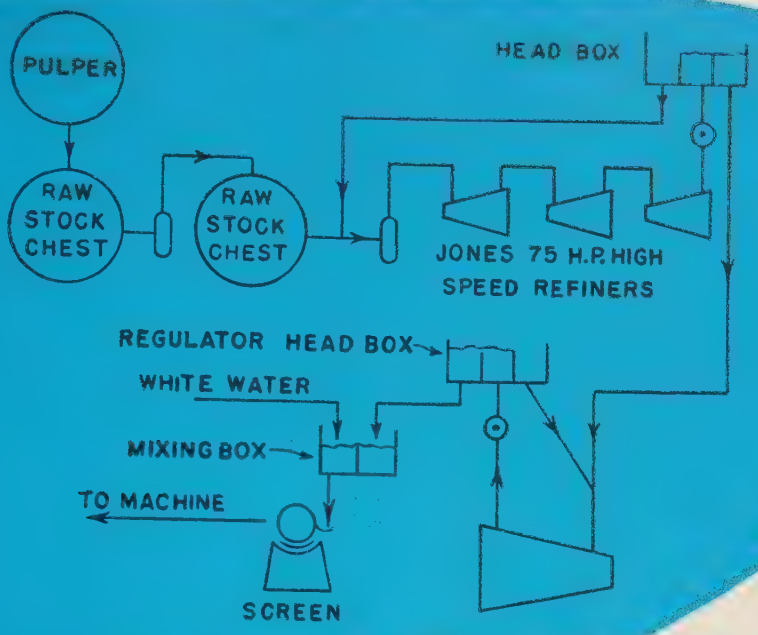
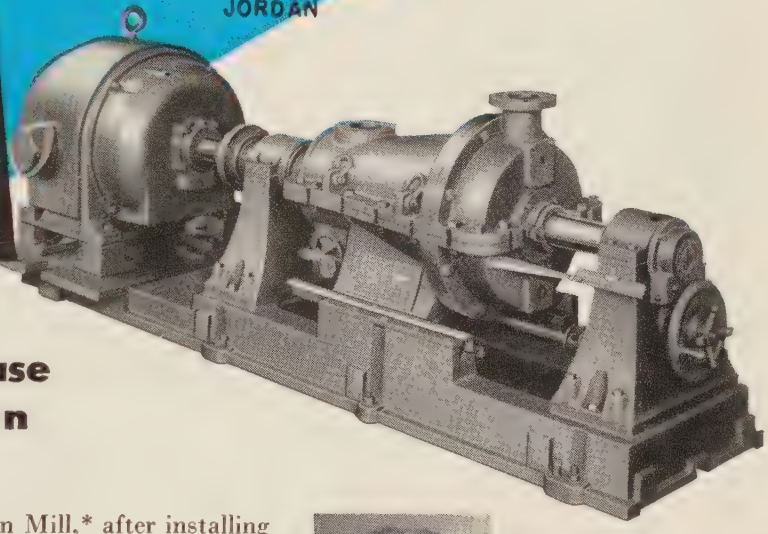
DRY MATERIAL CONVEYING SYSTEMS AND COOLERS — COMPRESSORS AND VACUUM PUMPS — FEEDERS, AND ASSOCIATED EQUIPMENT

A-129



JONES 150 H.P. STANDARD JORDAN



Old installation 800 connected h. p.
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SAVING 425 h. p.

Plus 10% increase in production

That's the record of a 3-machine Mexican Mill,* after installing the Jones equipment shown in the flow-chart above.

Three Jones High-Speed Refiners and one Standard Jordan replaced two 250-h.p. refiners and two 150-h.p. Jordans when this mill modernized the stock preparation for its largest paper machine — making about 20 t.p.d. of sulphite bonds and 12 to 14 t.p.d. of manifold papers.

The new installation has increased production by 10% while producing equal or better quality papers. Why don't *you* find out what the Jones High-Speed Refiner can do for your cost and quality controls? Ask your Jones representative or write direct for Bulletin EDJ-1011B.

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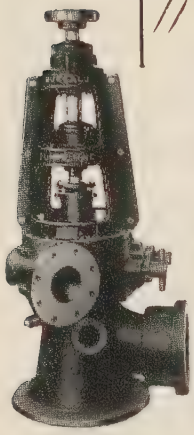

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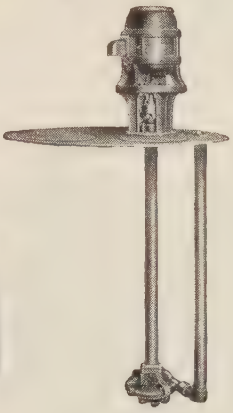

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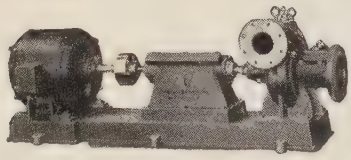

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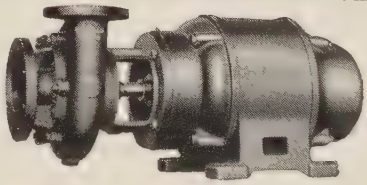

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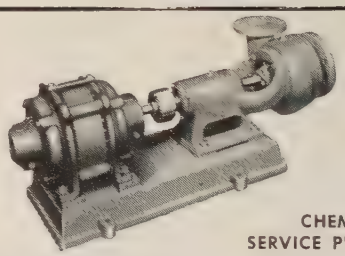

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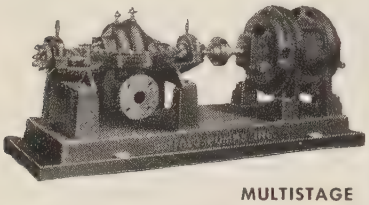

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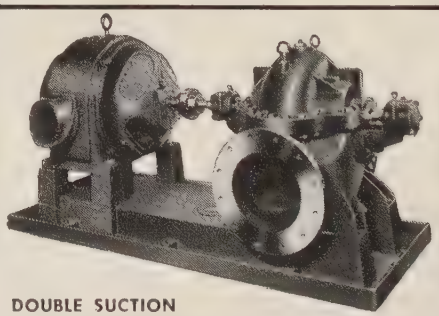

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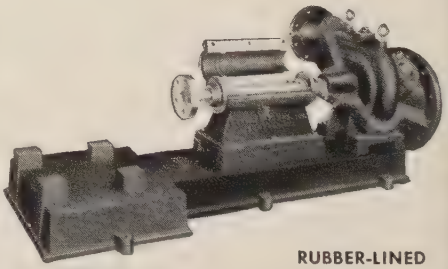
are hydraulically balanced and of finest obtainable construction. Bulletin 955.



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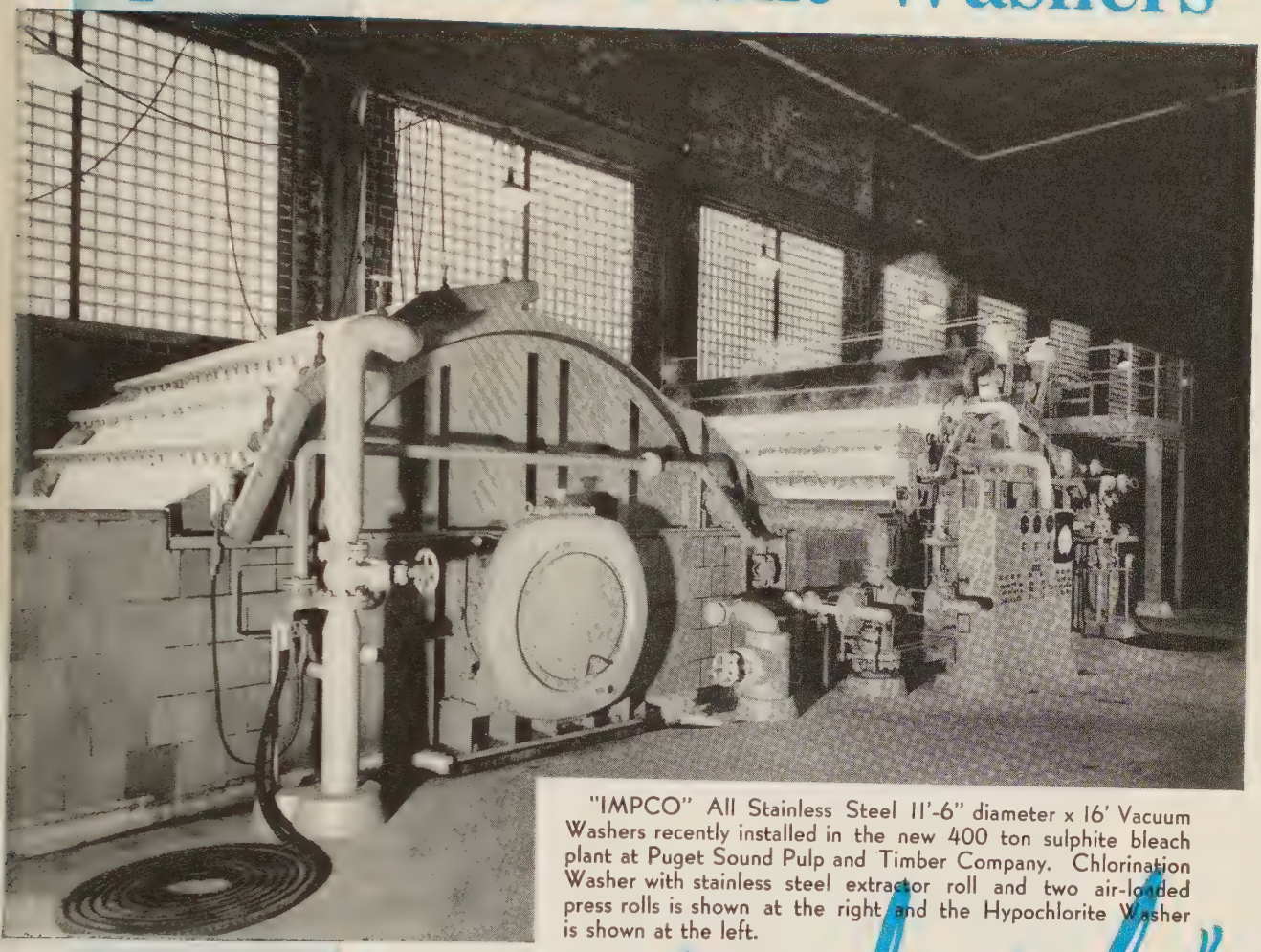
Impco Bleach Plant Washers



"IMPCO" All Stainless Steel 11'-6" diameter x 16' Vacuum Washers recently installed in the new 400 ton sulphite bleach plant at Puget Sound Pulp and Timber Company. Chlorination Washer with stainless steel extractor roll and two air-loaded press rolls is shown at the right and the Hypochlorite Washer is shown at the left.

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Every "IMPCO" Bleach Plant Washer is correctly engineered to fit your needs, to give you the necessary flexibility in tonnage and above all, quality production.

If you are planning a new bleach plant or an increase in production in your existing plant, "IMPCO" offers you a complete line of equipment for any type of system, including chlorine dioxide.

With an experienced "IMPCO" representative working step-by-step with your engineers, you can be sure of the answer that is best for you.

IMPROVED MACHINERY INC.
Nashua, New Hampshire

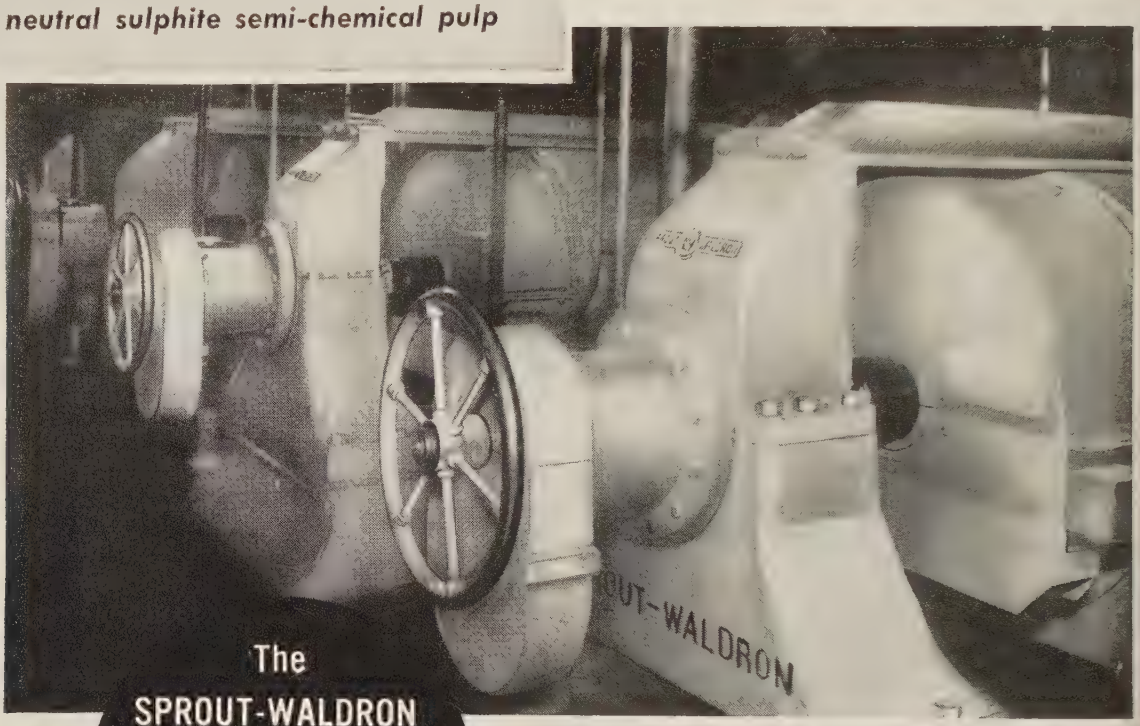
semi-chemical

To solve pulping problems economically...

Groveton Papers Company uses Sprout-Waldron Refiners

The first semi-chemical pulp mill in New England

uses four Sprout-Waldron 450 h.p. 36-2 Refiners to produce neutral sulphite semi-chemical pulp



The SPROUT-WALDRON refiner is the leading producer of semichemical pulp

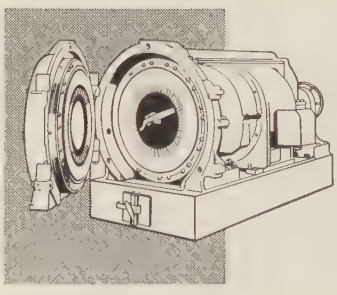
high pulp quality

rugged construction

high capacity

low maintenance

flexibility of operation



Want **more information** on semi-chemical pulping?
Send for our file of technical and practical data.
Write to Sprout-Waldron & Co., Inc.,
38 Logan Street, Muncy, Pennsylvania

SPROUT-WALDRON

PULP REFINERS

268-A

BECCO

HYDROGEN
PEROXIDE
AND OTHER
PEROXYGEN
CHEMICALS

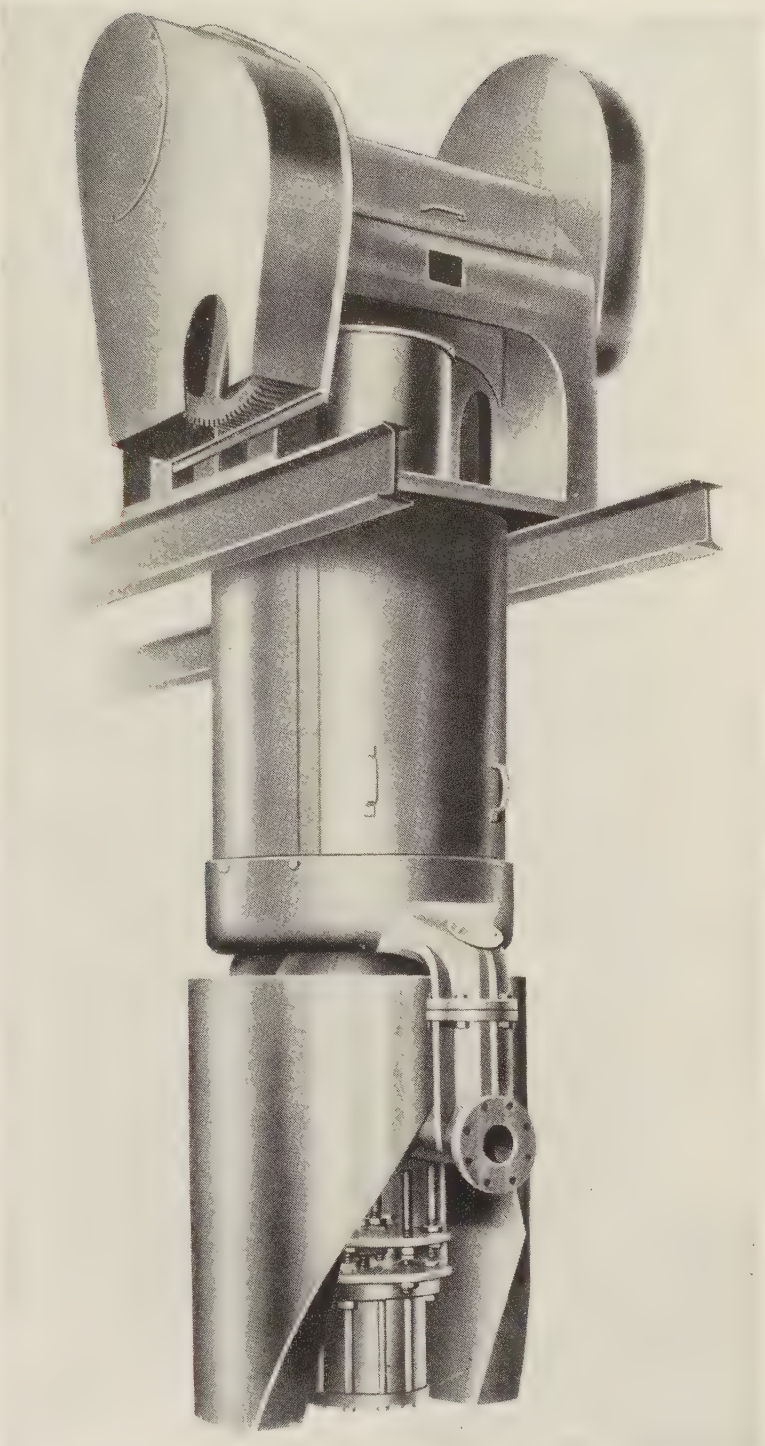
You Can Now Bleach Crumbs with Hydrogen Peroxide at High Density!

Continuous bleaching with Hydrogen Peroxide at 25%-40% density is now a reality for groundwood, semi-chemical, and chemical pulps in crumb form. Semi-continuous steeping of these pulps without retention towers is also a commercial operation. Screw presses will perform the function of de-watering to high densities.

The systems are characterized by their simplicity and low floor area requirements.

To obtain the same brightness level, chemical cost reductions due to high density operation (25%-40%) have been up to 20% for groundwood, up to 25% for neutral sulfite semi-chemical. and up to 45% for sulfite, compared with moderate density (10%-14%) systems.

For further information on the most efficient peroxide methods, write to Becco.



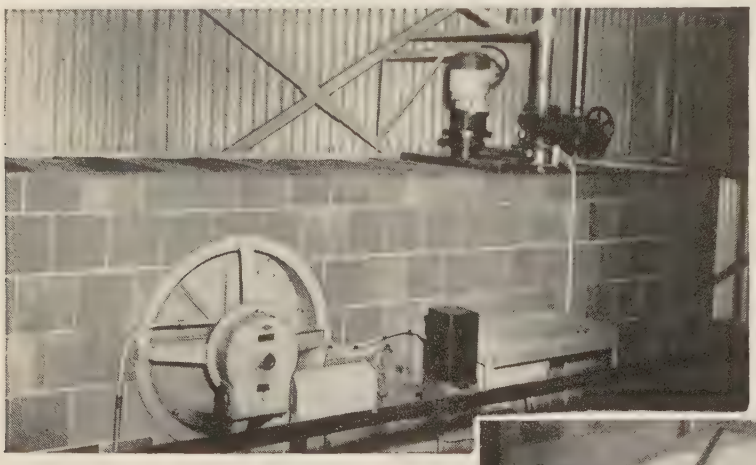
A Jackson & Church Zenith Medium Press typical for use in de-watering high density pulp crumbs.

Buffalo Electro-Chemical Company, Inc.

DIVISION OF FOOD MACHINERY AND CHEMICAL CORPORATION

Sales Agent: BECCO SALES CORPORATION, Station B, Buffdlo 7, N.Y. • Buffalo • Boston • Charlotte • Chicago • New York • Philadelphia • Vancouver, Wash.

Two More Modern Mills Rely on Stebbins Tanks and Linings to Protect Against Corrosion



Weyerhaeuser Timber Co.
Longview, Washington

At the new Kraft Paperboard Plant, 54,810 sq. ft. of Stebbins tile and linings contribute to efficient operation of the stock tanks, white-water chest, beater stock chests, wire pit, couch pit, vacuum sump pump, IMPCO washer vats, washer seal boxes, flat box sump, Oliver Saveall vat, IMPCO stock meter, chlorination tower, caustic towers and hypo tower.

Hollingworth & Whitney Co.
Mobile, Alabama

As part of the new expansion at Mobile, 32,761 sq. ft. of Stebbins tile gives corrosion resistance to the chlorination tower, sulphur dioxide tower, caustic towers, hypo towers, two 30′ diameter storage tanks, washer vats, stock meter and regulator, and head box. This is in addition to the complete Stebbins tile installation made in the first bleach plant erected in 1940.

Stebbins offers you a complete, nation-wide service—design, installation, maintenance and repair—on corrosion-resistant tanks and linings for acid and alkali conditions—one contract—one responsibilty, based on unequalled facilities and experience.

For the practical answer to your own corrosion problem, ask to have the Stebbins man in your community call on you.

CORPORATE EST. 1884 50th ANNIVERSARY INC. 1903

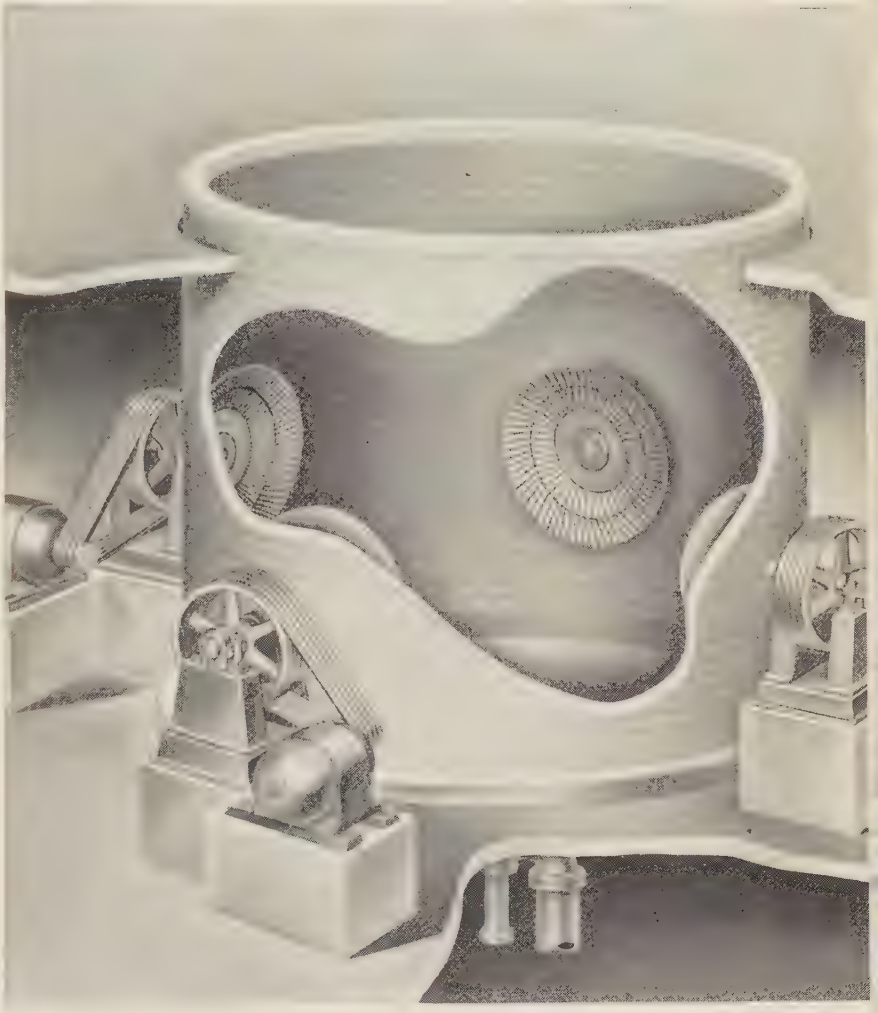
SINCE 1884
Specialists in Design Installation and Servicing of Linings and Tile Tanks

STEBBINS
Engineering and Manufacturing Company, Watertown, N. Y.
STEBBINS ENGINEERING CORP. – TEXTILE TOWER, SEATTLE, WASH.
CANADIAN STEBBINS ENGR. & MFG. CO., LTD. – CASTLE BLDG., MONTREAL, CANADA

RICE BARTON

QuatroPulper

. . . a high production machine . . . ideal for disintegrating pulp, broke or waste paper



stock is charged all at one time
e top of the vat. Four DynoPellers
ped below) subject it to the vigorous
izing action that completely separ-
ch fibre from its neighbor, maintain-
original length. The simple operating
le and design of the QuatroPulper
ates the "wracking" and grief of
types of pulpers. Because there are
oving parts there is no loss of pro-
n time due to repair or adjustment.
uatroPulper defibers the stock at low
nd produces a high quality slurry
and effectively.

The DynoPeller
is the heart of all DynoMachines. Its concave face is lined with rough, hard carbide particles. As the Dyno-Peller rotates it causes a suction at its center that pulls the stock toward it. Centrifugal force then causes the stock to flow rapidly over the rough carbide particles under a gentle hydraulic pressure. This effective dynomizing action completely disintegrates the stock . . . separating each fiber from its neighbor while maintaining its original length.

RICE BARTON *Research Corporation*
WORCESTER 1, MASS.

ACROSS A THIN STRIP OF PAPER TAPE, slightly less than three-fourths of an inch wide, moves the news that travels via teletype—in Government agencies, the Armed Forces, business offices and plants throughout the U. S.

Teletype tape called for a carefully engineered pulp that would meet many requirements—tensile strength that would resist tear yet not wear out the perforation pins . . . a minimum of fuzz and lint . . . the right amount of oil impregnation for speedy movement through the machines.

Engineered papers require the *right* pulps.

Coming up with the *right* pulps for special papers is a job the experts of our Technical Service Division have been doing for more than half a century. If you have a paper problem, perhaps they can help you, too.

Write to Dept. PD-4, in our Boston office.

BROWN COMPANY, Berlin, New Hampshire
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General Sales Offices: 150 Causeway Street, Boston 14, Mass.
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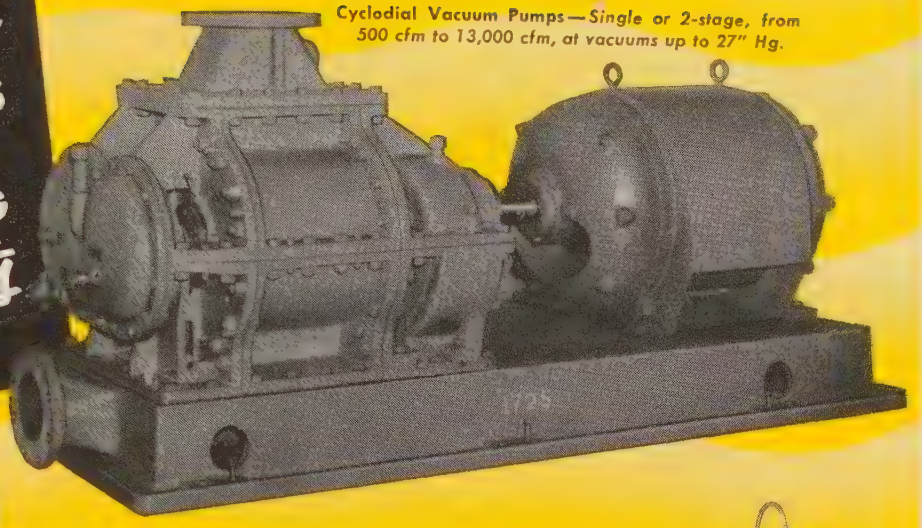
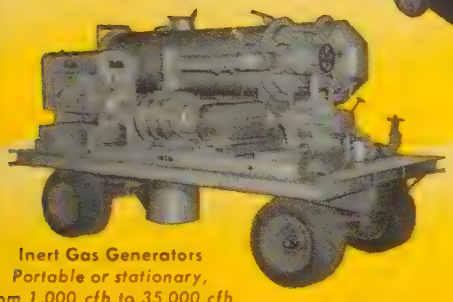
HIGH-EFFICIENCY VACUUM PUMPS BUILT BY AIR HANDLING *Specialists*

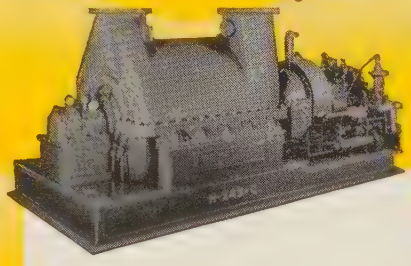


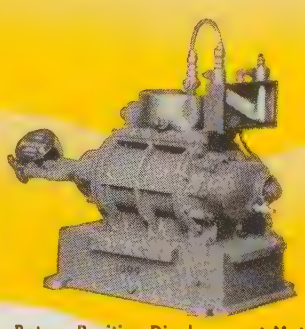
Cyclodial Vacuum Pumps—*Single or 2-stage, from 500 cfm to 13,000 cfm, at vacuums up to 27" Hg.*



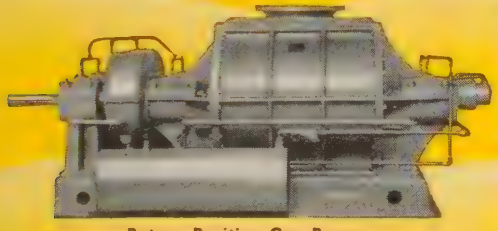
Inert Gas Generators
Portable or stationary, from 1,000 cfh to 35,000 cfh.

Centrifugal Blowers and Exhausters
Single and multi-stage, from 2,000 cfm to 100,000 cfm or higher.





Rotary Positive Displacement Meters
4,000 cfh to 1,000,000 cfh.



Rotary Positive Gas Pumps
5 cfm to 50,000 cfm.

Rotary Positive Blowers and Exhausters
5 cfm to 50,000 cfm.

The wide acceptance of R-C Vacuum Pumps is the result of extremely low cost for power and water, and proved long-time reliability of these simple rotary positive units. Further, because they operate at higher speeds (600 rpm and above), they require smaller motors, less floor space and lower foundation cost. This naturally reduces initial investment and thus increases the percentage of operation savings.

The successful performance of R-C Vacuum Pumps comes from almost a century of experience in handling air and gas. That is our exclusive business — we are "specialists" in that job. We are also the only builders of the *dual-ability* line of Centrifugal and Rotary Positive Blowers, Exhauster and Gas Pumps. Because of this, we can offer you the unbiased, *dual choice* of units that are best fitted to your requirements. And, the wide range of capacities of R-C equipment eliminates oversizing, thus reducing first cost and lowering operating expense.

For your present or future needs, you will get sound advice and competent co-operation by calling on Roots-Connersville specialists in handling gas or air.

ROOTS-CONNERSVILLE

Exclusive Specialists in Handling Gas and Air

BLOWER BUILDERS RC SINCE 1854

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534 Maple Ave. · Connersville, Indiana

"WHERE DO YOU GET YOUR ALKALIES, JIM?

"I ALWAYS GO TO SOLVAY *FIRST* FOR ALKALIES···*Here's why...*

REG. U. S. PAT. OFF

SOLVAY

Chemicals
For The
Paper Industry
SODA ASH
CAUSTIC SODA
LIQUID CHLORINE

...**First off, I've found** that Solvay always takes care of its customers—in good times and bad! I know I can really depend on Solvay in a pinch.

I also like the treatment I get from the sales staff—always courteous and helpful. And it's convenient doing business with Solvay because one of their sales offices is located near me.

In addition, I feel that when I buy alkalies, I might as well get the "extras" that Solvay offers ...like the Solvay Technical Bulletins that give you the kind of information no other technical bulletins have. Same with the Solvay Technical Service staff, a group that operates on an industry-wise basis, with men who are experts in individual industries.

Then Solvay has over 200 local stock points that practically cover the country, and three centrally located plants. This makes for better delivery service.

And, of course, I know I get dependable quality and uniformity when I order from America's oldest and largest producer. That's why I always go to *Solvay first* for alkalies.

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Specialty Cleansers • Sodium Nitrite • Para-dichlorobenzene • Ortho-dichlorobenzene • Monochlorobenzene • Ammonium Chloride • Sesquicarbonate of Soda

FOAM

beautiful here

but not here

Yes, foam is both decorative and useful in milady's bath, but certainly not in the pulp and paper mill where it retards production and lowers quality.

That's why today so many manufacturers are eliminating foam troubles with Nopco* foam killers and sheet formation aids. These superior formulations of liquid and paste defoamers destroy the most obstinate foam in a *matter of minutes*.

Take Nopco KFS, a semifluid paste, for example. Stable to chemicals such as alum and chlorine, and hard water, KFS is a lightning-fast "bubble buster". It provides extremely effective foam control at every stage in pulp and paper making from blow pit to calender color box. KFS, in fact, does a thorough job of foam elimination no matter how great the volume or speed of mill production.

Why not order enough KFS for a trial run? It is easily made into a stable emulsion by simple agitation. And Nopco specialists will gladly work closely with you, right in your mill if you wish, to make certain that you get the best possible results.

Write for free bulletin: "Nopco KF Series Dispersing Agents"—giving valuable tips on how to improve sheet formation.*

*Reg. U.S. Pat. Off.

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CHEMICAL COMPANY Harrison, N. J.

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Established 1886

"Time ripens all things. No man is born wise."

CERVANTES

Organizations are the lengthened shadows of the men who make them up; and organizations, like men, learn and build through the years.

With changing times and conditions, with a constant succession of new problems met and solved, they accumulate knowledge and experience of solid, practical value.

Sixty-seven years of intensive and extensive working with the Pulp and Paper Industry have equipped us to serve you well.

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GOTTESMAN & COMPANY

— INCORPORATED —

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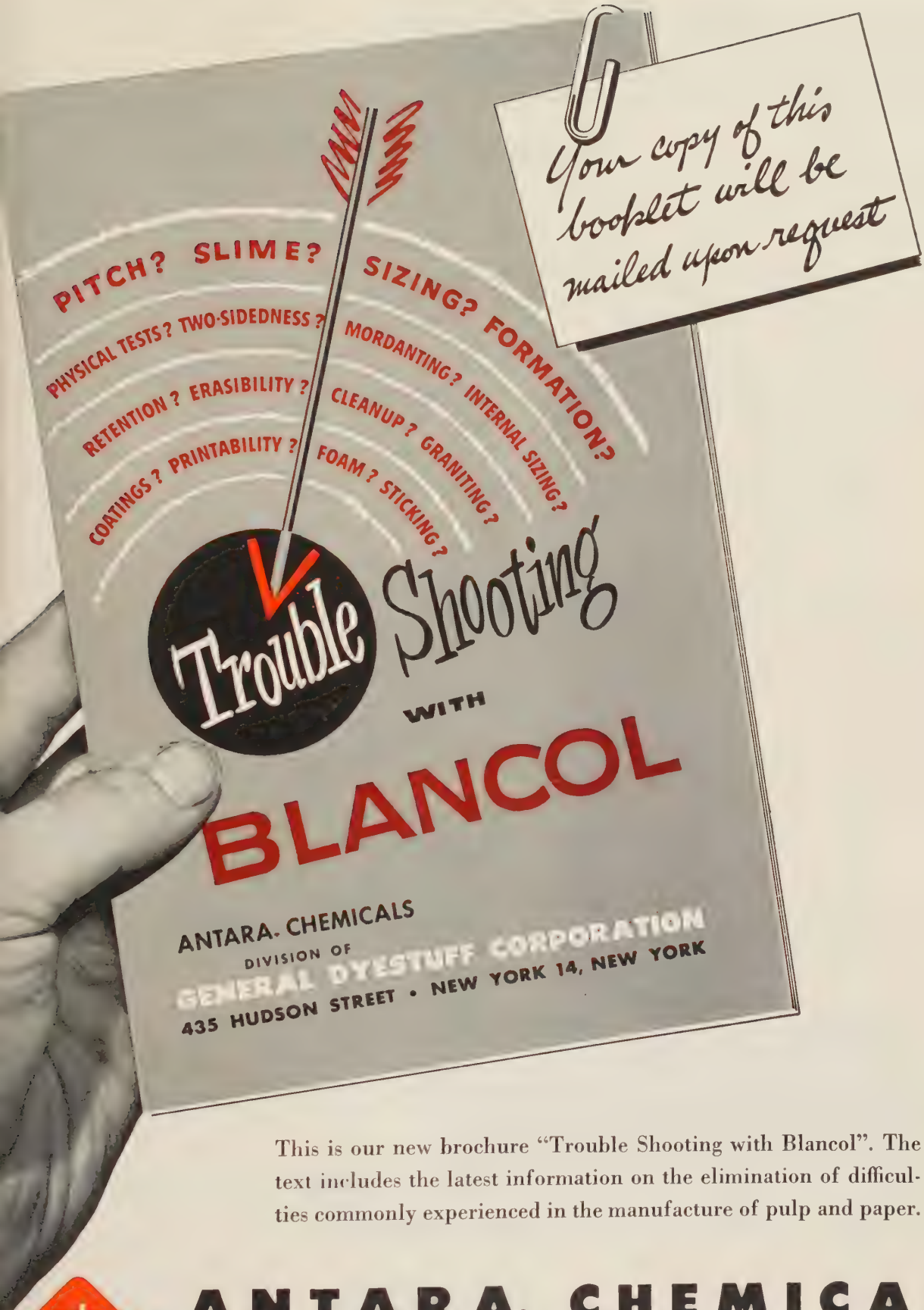


This is our new brochure "Trouble Shooting with Blancol". The text includes the latest information on the elimination of difficulties commonly experienced in the manufacture of pulp and paper.

gdc ANTARA

ANTARA® CHEMICALS

DIVISION OF

GENERAL DYESTUFF CORPORATION

435 HUDSON STREET • NEW YORK 14, NEW YORK

What'll you have...

1 revolving disc or 2?

This is a rhetorical question—a question not intended to elicit a direct answer, but to provoke thought.

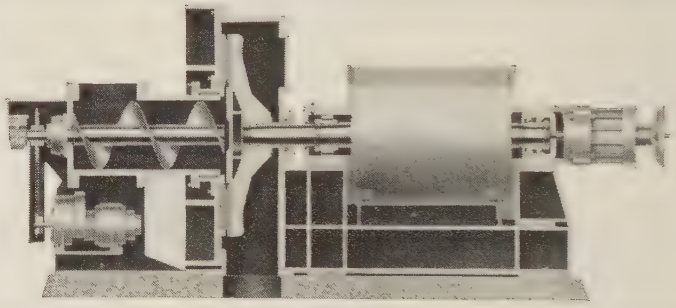
We make refiners with single or double revolving discs. Both types, of precision design, are illustrated on this page.

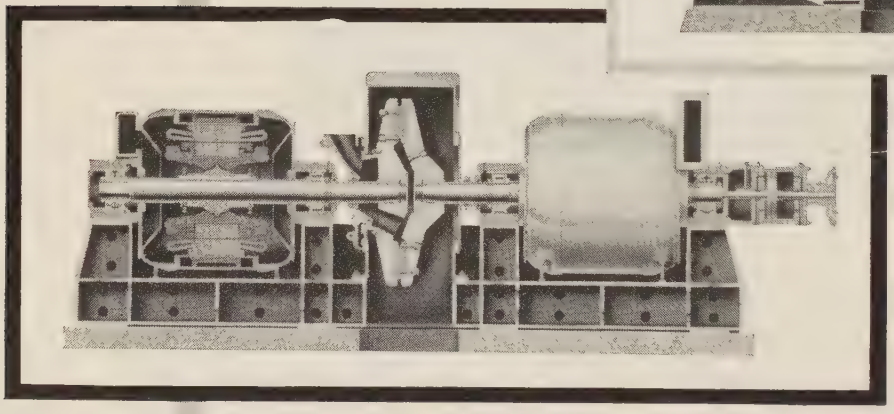
Generally speaking, the single revolving disc refiner, operating at relatively low speed, is employed when the objective is mullen development, while the double revolving disc refiner is used at higher speeds when the main requirement is defibering or dispersing.

But many considerations enter into the selection of the refiner or refiners for a particular situation. We can usually make a proposal based on experience. If not, we find the answer by running tests on commercial machines in our research laboratory.

Hundreds of Bauer disc machines are contributing toward better and more economical products in pulp and paper mills all over the world. We'll be glad to give you specific information.

Bauer No. 510 Single Revolving Disc Refiner. Both the revolving and stationary discs are 40" dia. Five other models and sizes from 8" to 48" dia. with 10 to 750 h.p. motors.





Bauer No. 410 Double Revolving Disc Refiner. Both discs 40" dia.; two 400 h.p. motors. Three other models and sizes from 24" to 36" dia., each with two motors totaling 50 to 400 h.p.

THE Bauer BROS. CO.

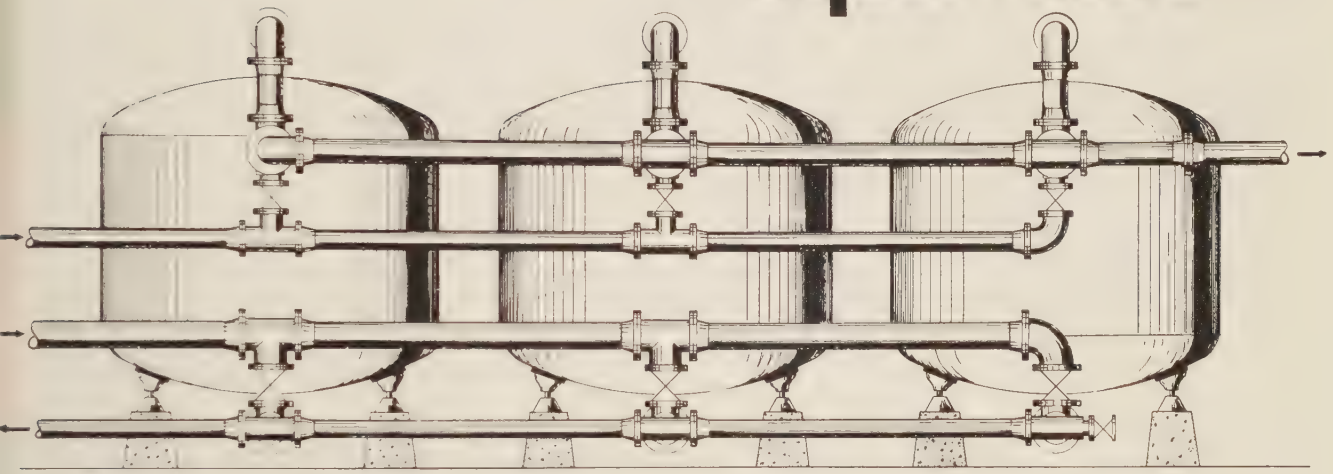
1715 SHERIDAN AVE.
SPRINGFIELD, OHIO

IMPROVE

Kraft and Soda Mill Operations

WITH

INFILCO Cooking Liquor Filters



TO

1. Increase pulp purity and brightness by removing calcium carbonate and iron.
2. Reduce caustic requirements by using filtered cooking liquor for caustic extraction.
3. Eliminate scale in heaters and in piping.
4. Increase liquor room capacity.
5. Improve sizing efficiency.

INFILCO engineers can assist whenever cooking filtration, water purification or mill waste treatment are being considered. **WRITE TODAY.**

MORE INFORMATION...NO OBLIGATION

INFILCO INC., P. O. Box 5033-T, Tucson, Arizona.

Please send more information regarding:

( ) Water purification ( ) Cooking liquor filtration

( ) Mill waste treatment ( ) Please have Field Engineer call

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COMPANY_____

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INFILCO

INFILCO INC. *Tucson, Arizona*

Plants in Chicago and Joliet, Illinois

FIELD OFFICES IN 26 PRINCIPAL CITIES

production increased up to 15 tons per day...

. . . with W & T chlorination equipment

A Southern mill had been having trouble with paper breaks attributable to the presence of slime in their white water. Despite continued efforts to control them slime breaks were running 60 to 80 per week, resulting in a time loss of 10 to 14 hours per week, and an average production loss of 15 tons per day! It was then that the W&T man was called in. Where and how to apply the proper treatment was determined, the costly methods were discontinued, and W&T chlorination was installed.

During the first 3 days of chlorination the mill recorded only 1 slime break and 2 minutes of lost time.

During the next 3 days there were 4 breaks and 17 minutes of lost time.

During the next 25 days there were no breaks attributable to slime!

. . . Within a week there were no production losses caused by slime! Performance such as that is typical of what your W&T representative can do for you.

If you have a production problem attributable to impure water, it would pay you to write or call him now.

WALLACE & TIERNAN
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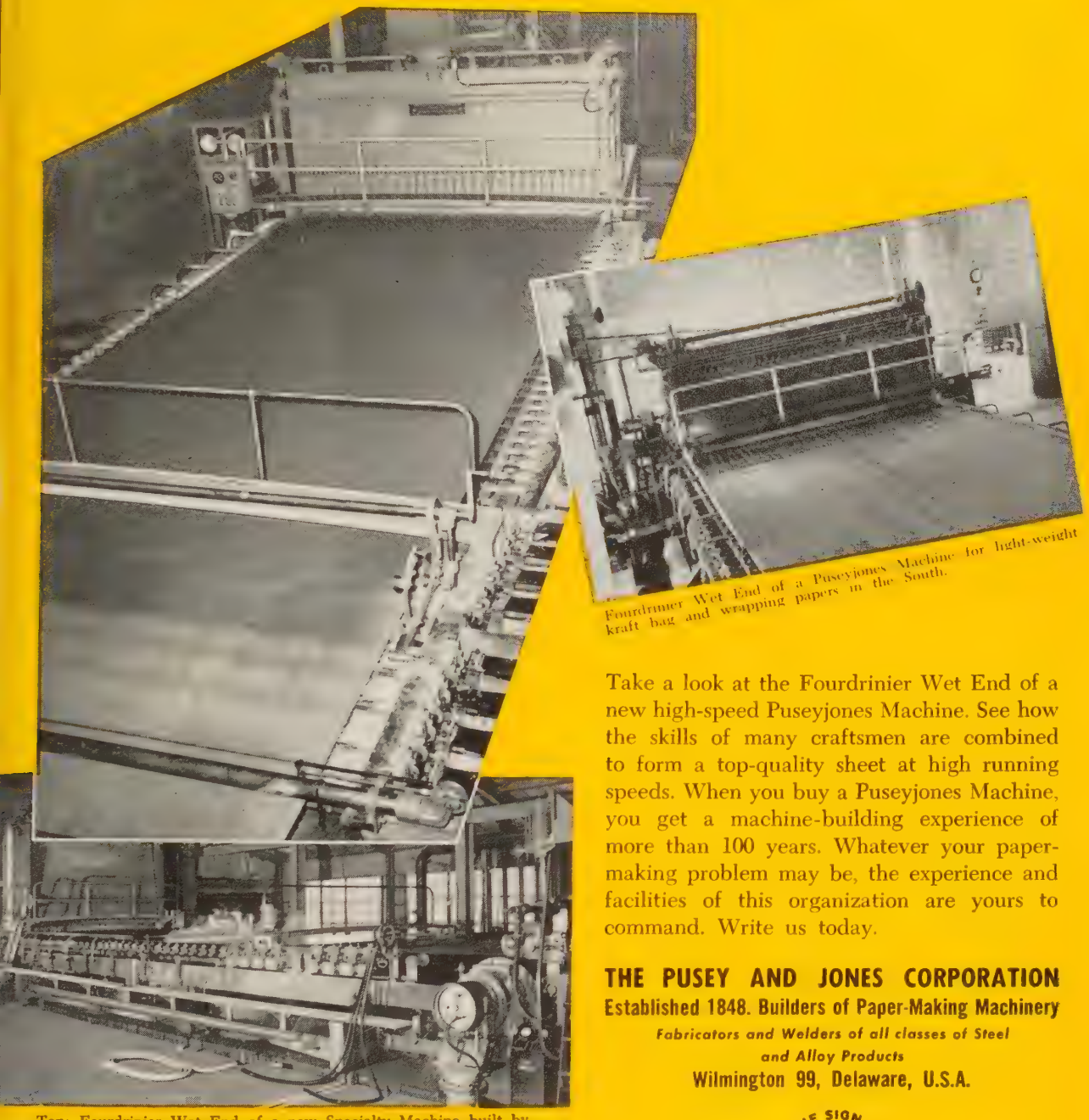
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

I-42

Puseyjones at Work

When the Sheet is on the Wire . . .



Fourdrinier Wet End of a Puseyjones Machine for light-weight kraft bag and wrapping papers in the South.

Top: Fourdrinier Wet End of a new Specialty Machine built by Puseyjones for a large mill in the Middle West.

Bottom: Rapi-Drape Wire Handling for new or existing machines is one of the many design improvements and labor-saving devices developed by Puseyjones.

Take a look at the Fourdrinier Wet End of a new high-speed Puseyjones Machine. See how the skills of many craftsmen are combined to form a top-quality sheet at high running speeds. When you buy a Puseyjones Machine, you get a machine-building experience of more than 100 years. Whatever your paper-making problem may be, the experience and facilities of this organization are yours to command. Write us today.

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Wilmington 99, Delaware, U.S.A.

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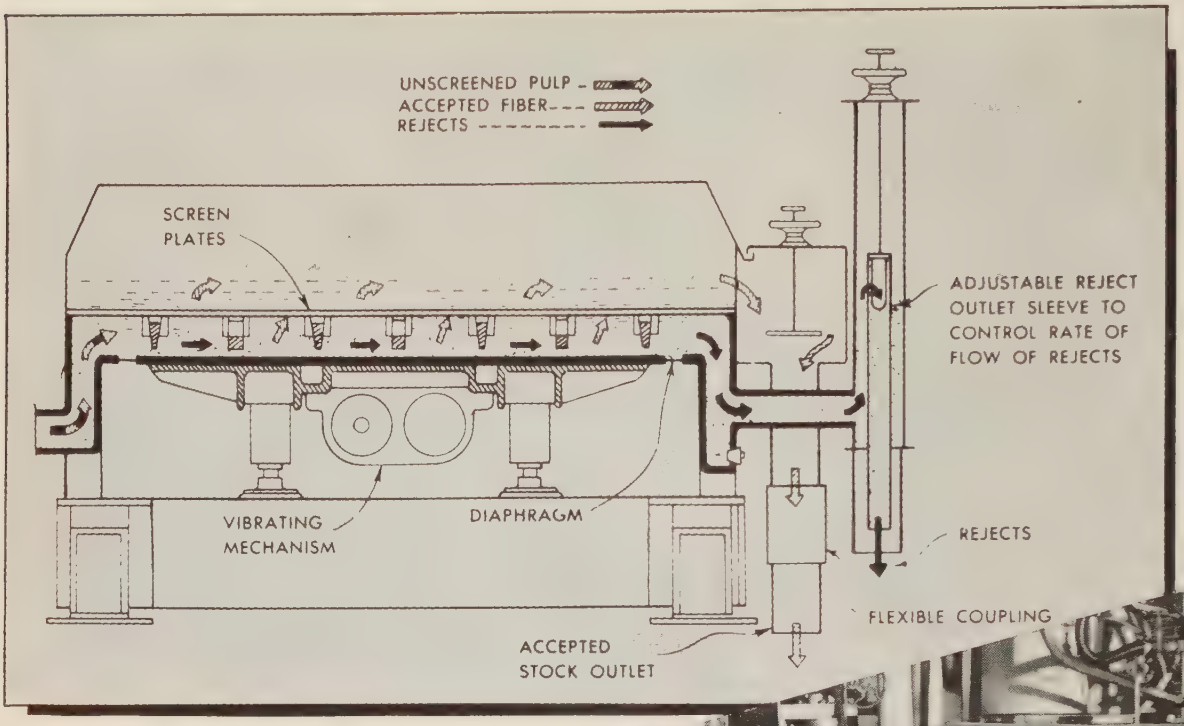
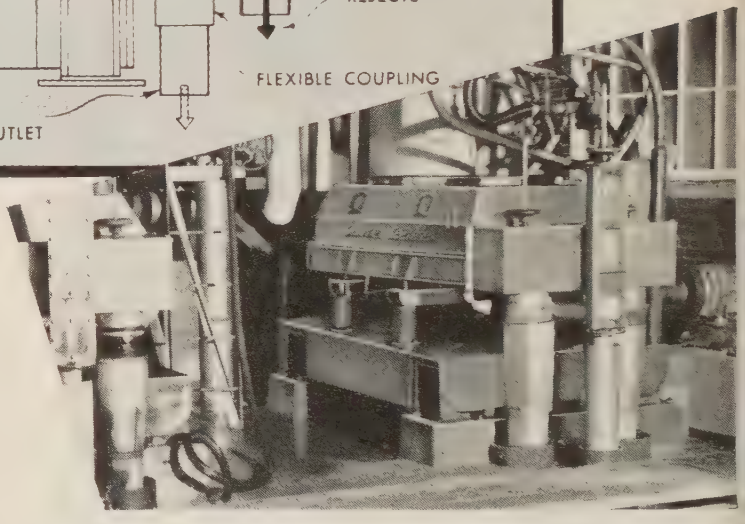
OLIVER-AHLFORS UPFLOW Pulp Screen

Shives, Dirt and Other Rejects Are Licked Before They Get Started





Study this diagramatic sketch. Note how unwanted solids in the pulp—many being denser and heavier—fall away from the wanted fibers in the pre-screening compartment. They're licked before they ever get started. Most don't even reach the screening surface. Certainly they don't tend to force their way through the slotted openings along with good fibers as they do with down flow screens.

This is the distinctive advantage of the Oliver-Ahlfors Pulp Screen! Other advantages include:

1. **Entire screen surface constantly operating at full capacity;**
2. **Requires approximately one half of floor space compared to conventional flat screens;**
3. **Continuous automatic screen plate cleaning, minimizes operator attention;**
4. **Screens at high density reducing required decker capacity.**

As for its application: The Oliver-Ahlfors Screen is recommended as a primary and secondary screen on all bleached or unbleached chemical pulp. Let us know when it will be convenient and we'll have one of our experienced pulp and paper engineers call to discuss your requirements and to tell you about the screens operating in this country as well as in many mills in Europe.

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the difference is

Better Alkaline Resistance with CYRON*

Cyanamid's New Synthetic Size!

IT ANSWERS THE ALKALINE PROBLEM!

CYRON Synthetic Size can be fixed in your paper stocks under alkaline or acid conditions — and you can achieve excellent alkaline resistance in the finished papers . . . opening the way to new sales-making uses! No broke problems either . . . CYRON-treated paper is easily repulped in the usual manner.

IT GIVES HIGH WATER AND INK RESISTANCE TO BEATER STOCKS!

Add CYRON Synthetic Size to your alkaline or acid beater stocks and you'll gain excellent water and ink resistance without adding rosin, alum or wax!

IT CUTS DOWN "CURL"!

You'll find your CYRON-sized papers have less tendency to curl under moist conditions; and your coating raw stocks "coat" more uniformly and to a lesser depth — giving smoother, better printing surfaces.

IT'S SIMPLE TO APPLY!

You need no special equipment; apply CYRON internally or on the surface of paper.

IT'S MAKING HEADLINE NEWS!

The applications for which CYRON's special properties are suited are many, with others still being explored. Your processes, your markets may call for just such an efficient sizing agent as CYRON. Your Cyanamid Technical Service man will be glad to give you full information, or you may *send for Technical Bulletin No. 29.*

yanamid Paper Chemicals: ACCOBRITE® Rosin Size • ACCOCEL® Dispersants EROSIZE® Sizing Emulsions • AEROSOL® Wetting Agents • ALWAX* and WAXINE® ax Sizes • AZITE® 900 Liquefier • CALMICRO® Calcium Carbonate • CYFOR® Rosin zes • CYNOL* Rewetting and Softening Agents • CYRON* Synthetic Size • PAREZ® et-Strength Resins • Rosin Size — Liquid and Dry • Aluminum Sulfate • Sodium nospho Aluminate • Clays • Defoamers and other Specialty Products • Acids Alkalis • Other Heavy Chemicals

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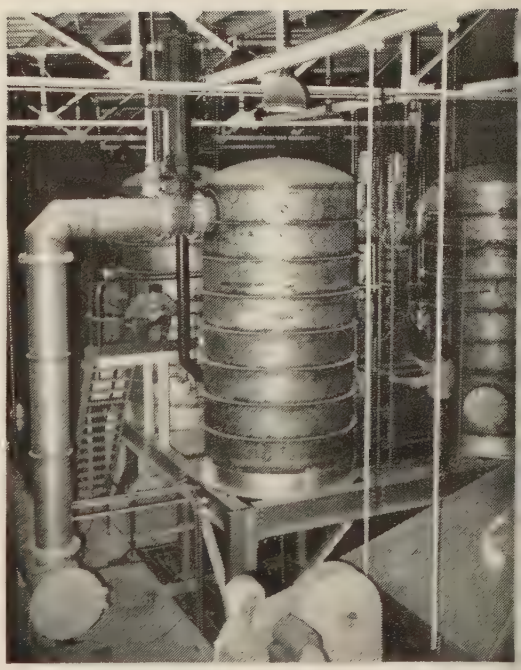

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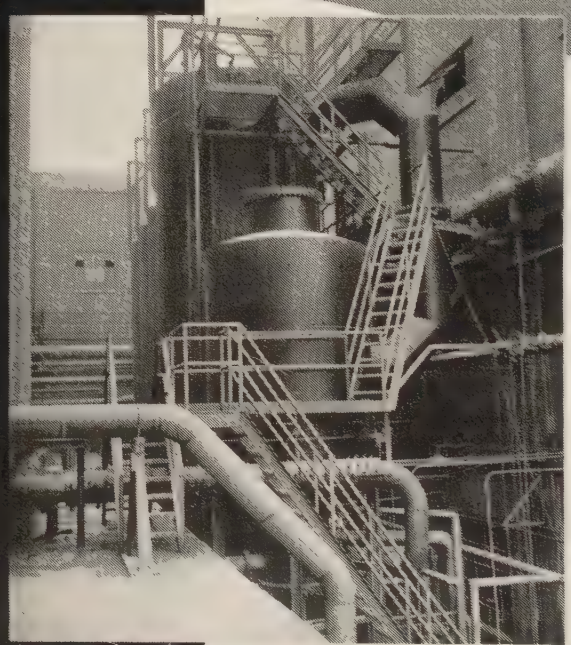

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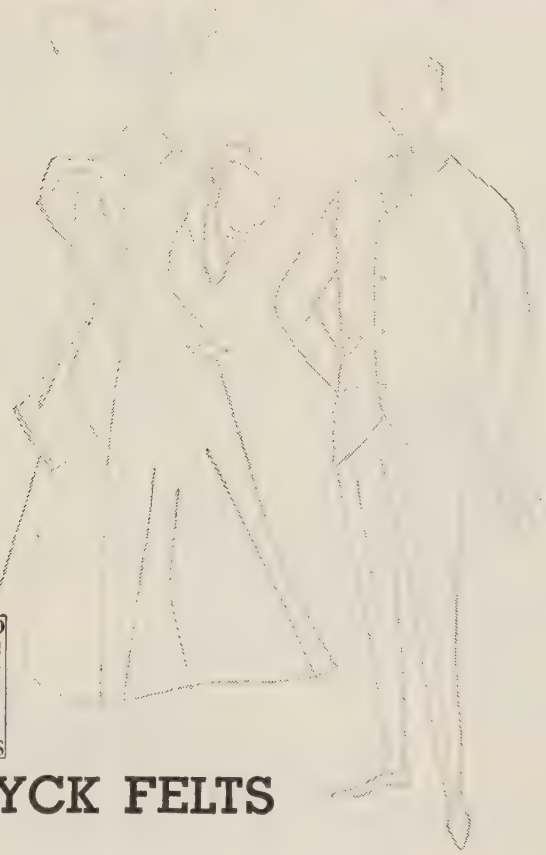

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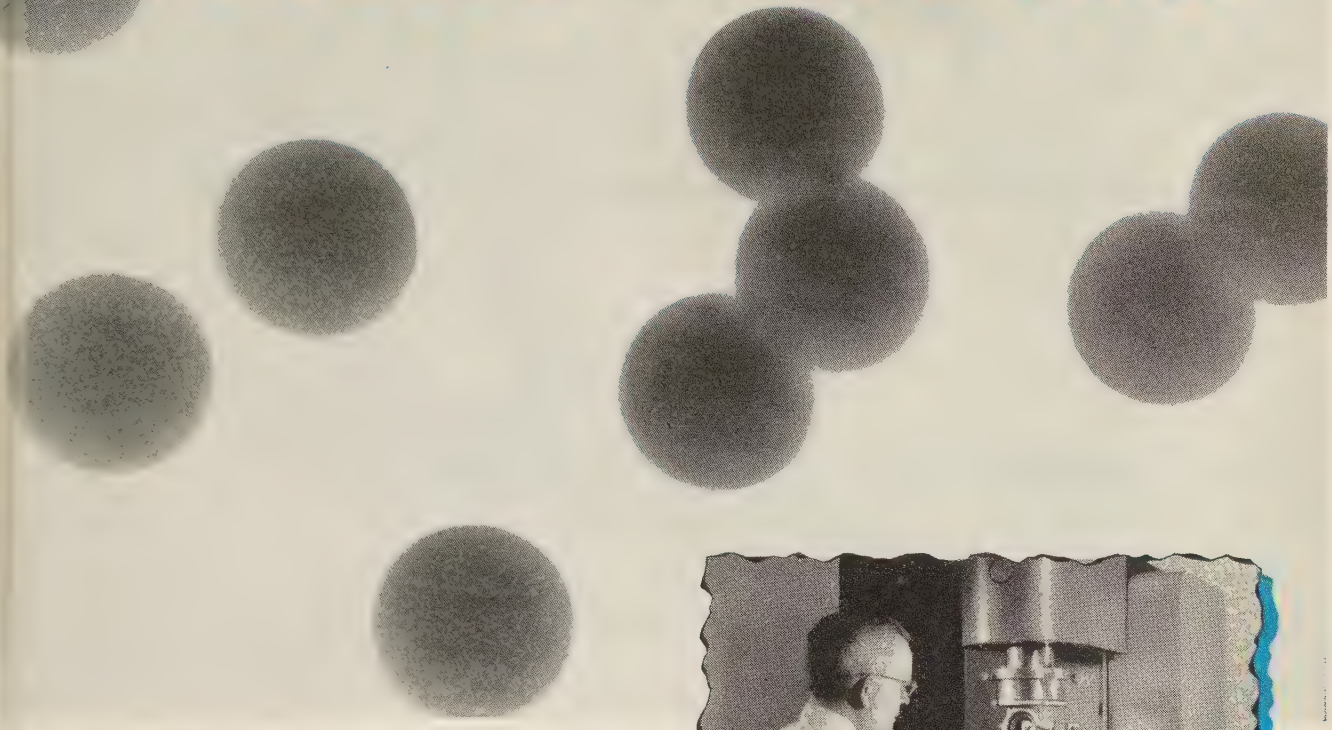

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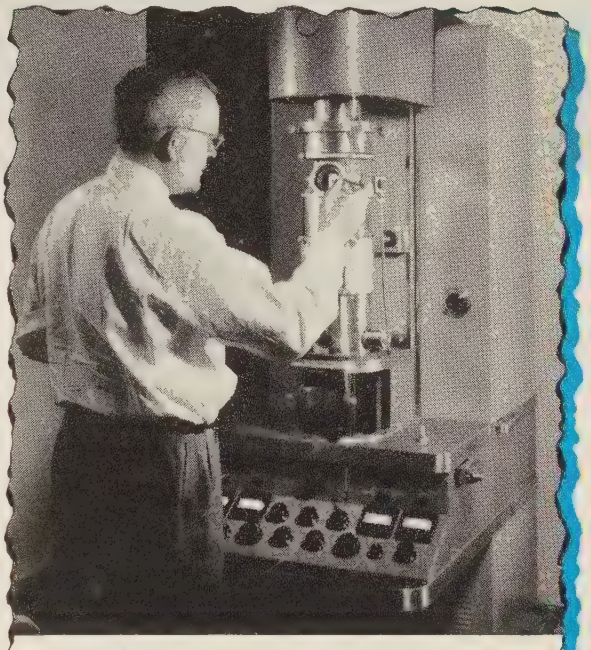

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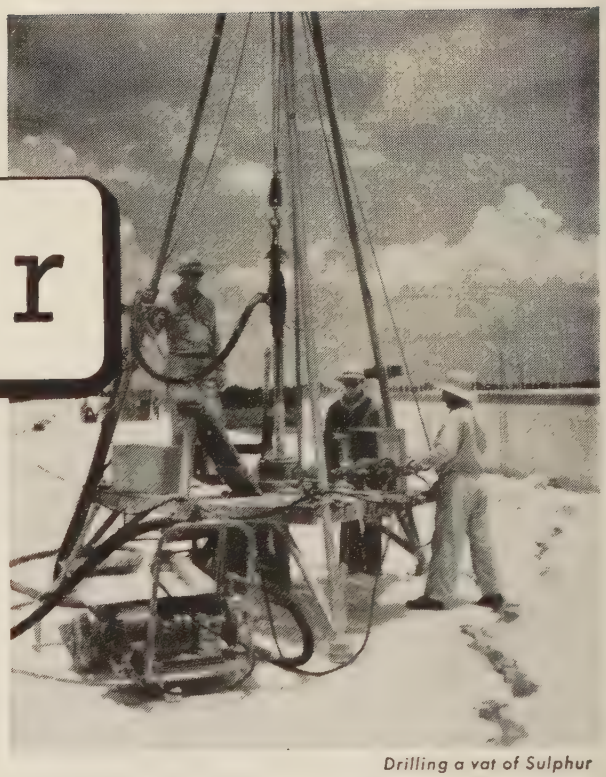

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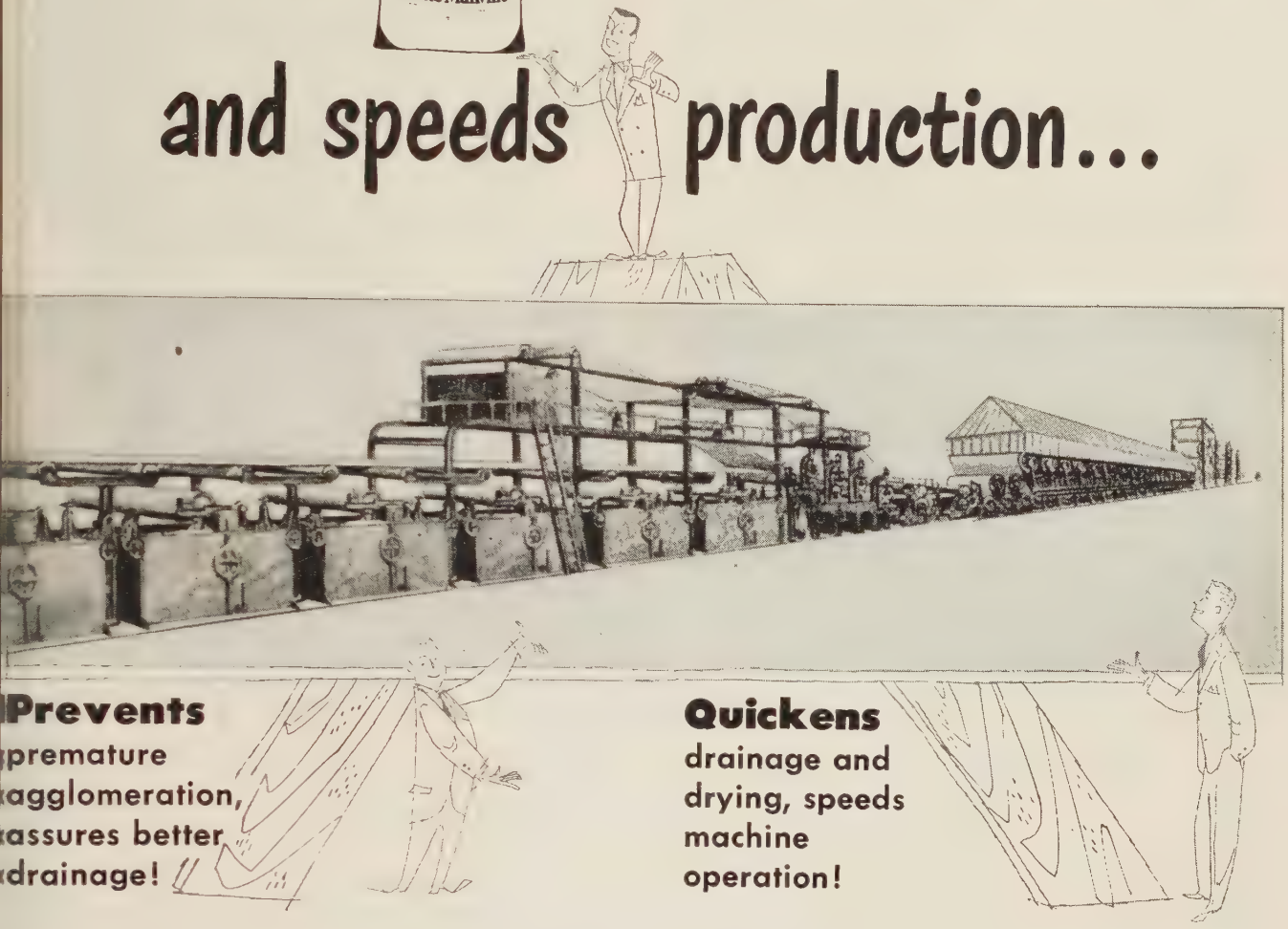

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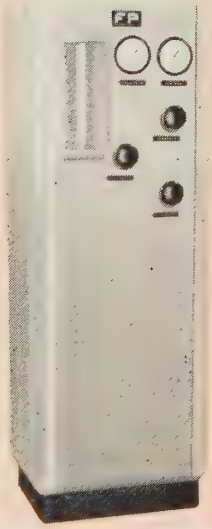

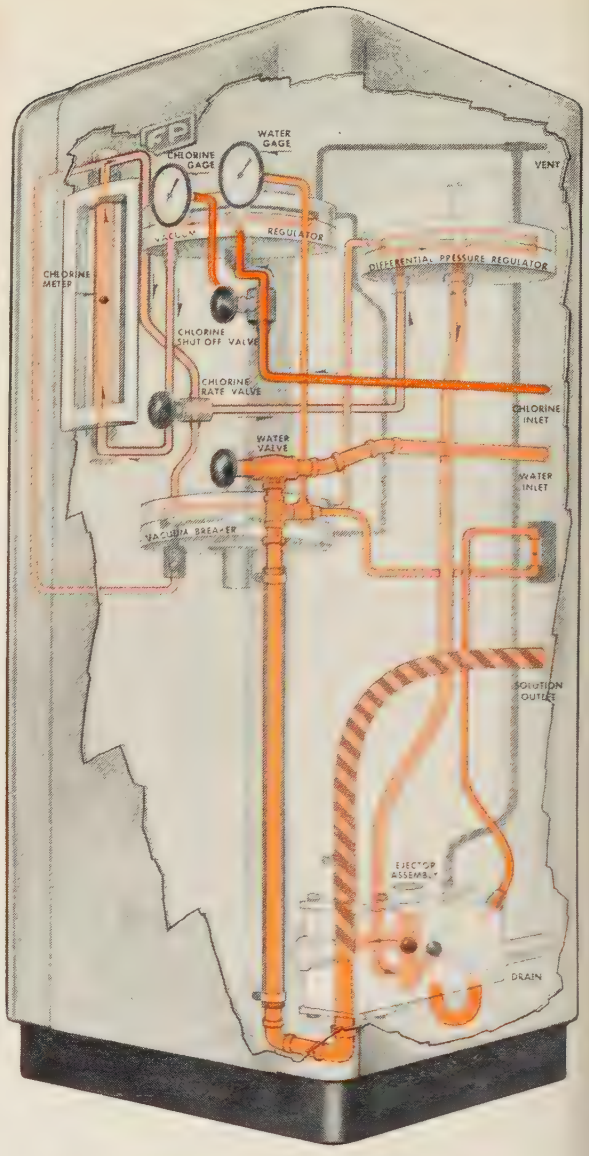

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LLOYD HORNBOSTEL

ed of open-type paper machines is limited by safety of ration at draw between suction couch and first press with maximum safe speed being a function of basis ght. Conventional pick-up felt operation eliminates s limitation but is deficient in that excessive water is ried to the press section, sheet strength is damaged, e fiber is left behind on the fourdrinier wire, and new hing sometimes necessitates reduced machine speeds. tion pick-up arrangement was installed by Beloit Iron rks experimentally in 1931 and 1932, with recently im-ved types operating successfully at speeds in excess of 00 f.p.m. The value of automatic transfer equipment in ws mills, for example, is indicated as: making possible reases in production of existing machines approximat-35%, providing paper with better printing character-ics due to increased groundwood content, reducing aks on machines by at least 75%, reducing chemical lp content of sheet from 20 to 10%, helping in forestry nservation programs by reason of reduced shrinkage of oundwood over chemical pulp in furnish.

THIS paper is concerned with the press section a paper machine; however, it is necessary to nsider the machine as a whole in arriving at the ake-up of this section. In designing the press sec-on of a paper machine the main thought that must be pt in mind is to make it as simple as possible while at e same time have it safe operating and deliver a sheet the drier section with a maximum dryness. The ess section must be constructed so that it is not the ttleneck of the machine, and also be made to give e desired characteristics to the sheet during the de-atering process.

The simplest or open type of press section which can made up of one or more suction presses, each hav-g their own felt, will be considered first. Omitting other limitations, such as formation, drying, etc., e open press section is limited in speed only by how st the sheet will run safely from the suction couch to e first press felt. This is the first place that the com-ratively wet sheet supports itself across an open aw. Speaking generally, this safe speed can be own as a function of sheet weight. This relationship ll vary for different types of stock, but a typical rve is shown in Fig. 1.

Now let us take an example and say that we desire make a 17-lb. sheet. If we use the simplest press tion, namely, the open type, we will have to limit e speed of the machine to something around 800 .m. Safety of the first draw from the couch will be e limiting factor. In the past, efforts to increase the eed beyond 800 ft. would have resulted in the decision use a conventional, pickup felt type of press section.

YD HORNBOSTEL, Vice-President in charge of Engineering, Beloit Iron rks, Beloit, Wis.

This is shown in Fig. 2. Here a tightly woven dense type of felt, known as a pickup felt, is used to pick the sheet off the wire and convey it through the press section.

The operation of this type of press section will be considered in some detail as it has some serious limitations that are eliminated in the latest suction pickup arrangements. The sheet is first picked from the wire by the pickup felt. This is accomplished by three effects working together. First, the sheet as well as the felt are fairly wet when brought in contact, which, to some extent, locks the sheet and felt together.

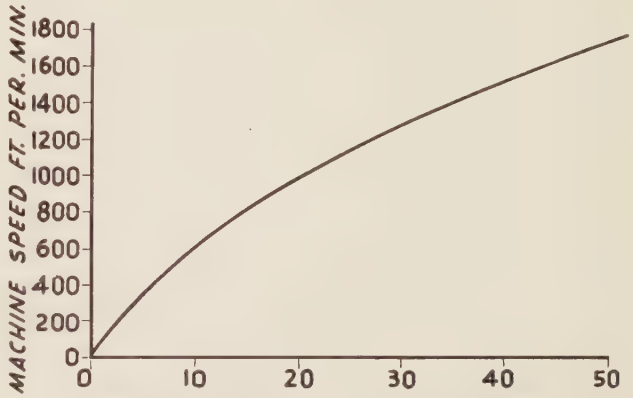

Fig. 1

Second, the felt, having been singed, is more or less like a brush with the bristles sticking up, and they are pushed into the wet sheet which helps to lift it off the wire. Third, as the felt leaves the wire, it is wrapped against the top roll so that air cannot pass through the felt. However, the wire is usually supported on a grooved bottom roll so that air can get under the wire. The effect of this is the same as if a sheet of paper is laid on an open grate of some kind with a book on top of the paper. If the book is raised quickly, the sheet of paper will stick to the book, and lift it off the wire or grate.

In the suction pickup arrangement, this third principle is employed, only a very open type felt is used and the suction roll in back of the felt is directly over a span of the wire so that air can come through the wire very readily and lift the sheet off the wire onto the felt (see Fig. 3).

The various limitations, problems, etc., of the plain conventional pickup have been known by Beloit Iron Works for a good many years, and there have been

many experiments and different combinations tried to help improve it. Once the sheet is on the pickup felt, it is run through one or more presses and then usually transferred to some kind of transfer roll or drier. A press section of this type is fairly satisfactory, however, it is not as efficient in a water removing capacity nor does

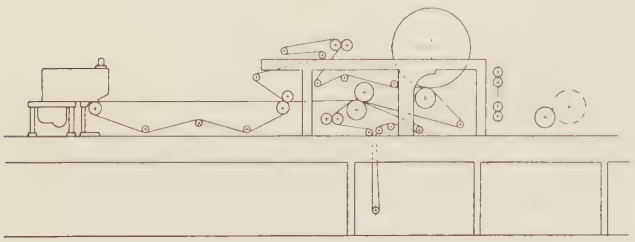

Fig 2. Yankee machine

the sheet retain as much of its strength characteristics as when an open press section is used. There is still another fault, namely, that there is quite a bit of fiber from the sheet left on the wire after the pickup operation. There are also times when starting a new felt that the machine has to be slowed down.

The impression that a conventional pickup felt machine is not a satisfactory arrangement should not be gained for that is far from the case. There are a great many of them in use and they do an excellent job. However, the author is only trying to outline their troubles and limitations and then show where the suction pickup arrangement eliminates these problems. To overcome the known troubles with the conventional pickup felt press section, Beloit has continually been working on suction pickup combinations. One of the earliest full-size Beloit machine installations was in 1932. This was a 175-in. machine. Another Beloit installation was tried on a 132-in. machine in 1931.

Looking back, considering what we know today, the most serious defects in these early installations were that the old conventional pickup felt ideas and traditions were too closely followed. The sheet was too wet when we tried to suck it off the wire, and the press sections that followed were too much like the conventional pickup felt layouts of that time. The first real break from the old traditions came in 1944 and on this Beloit installation, the sheet was dried more on the wire before being lifted off by suction. With the old conventional pickup arrangements the sheet was perhaps around 10% moisture-free at pickup, and the first suction pickup installations had it slightly drier, say, 12% moisture-free. Then, on the 1944 Beloit installation, this figure went to perhaps 17% moisture-free. The 1944 suction pickup machine had some limitations in its press part; however, it showed the way for the present highly successful installations of today which are mainly of two types as shown in Figs. 4 and 5.

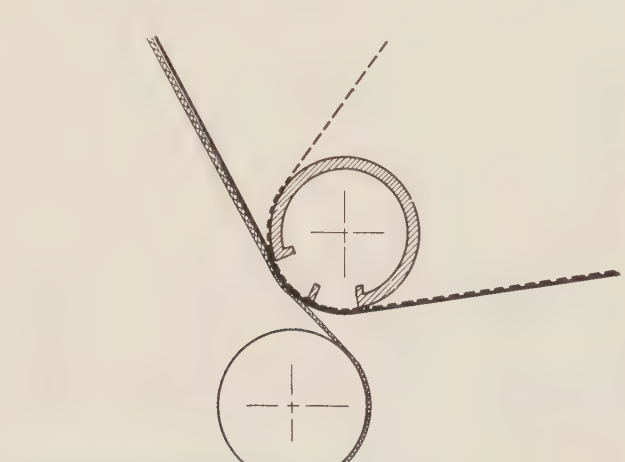

Fig. 3. Vacuum transfer

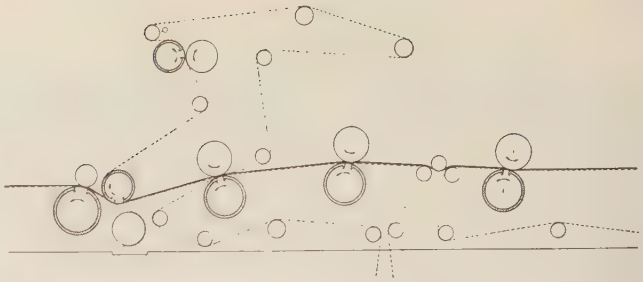

Fig. 4. Rebuilt press section high-speed newsprint machine

These suction pickups are Beloit developed and engineered and are the first suction pickup installations to run highly successful at speeds over 1700 f.p.m. for the Fig. 4 type and over 1900 f.p.m. for the Fig. 5 type. These suction arrangements not only give safe and dependable pickup, but the following press parts are highly efficient as water-removing units as well. It is believed, so far, that these are the only suction pickup and press arrangements that give both those features, namely, good and complete pickup and maximum dryness of the sheet to the driers. The first installation of the type shown in Fig. 4 was at the Port Angeles mill of the Crown Zellerbach Corp., and the first installation of the type shown in Fig. 5 was at the Crossett Lumber Co. plant at Crossett, Ark.

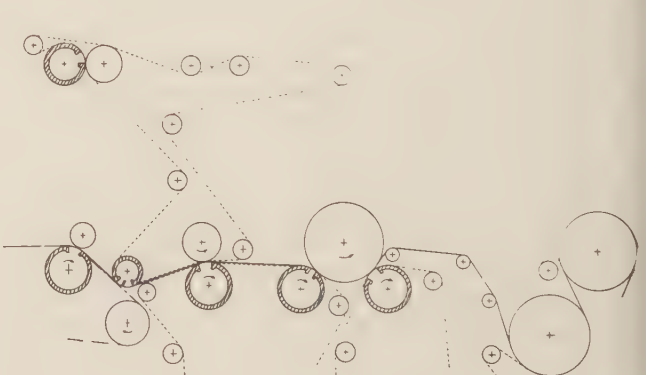

Fig. 5. Press section high-speed kraft machine

At the present time, several suction pickup machines having press sections similar to those shown in Figs. 4 and 5 are being built. Also experiments are being conducted with improvements in suction pickup on an experimental press section installed at Beloit. Nothing in the paper industry is stable, as you well know, and already improvements to these arrangements are in

process of development. We have gone far enough to be able to say that in the very near future, we will have further important improvements in suction pickup press sections. In fact, we are so confident of our new designs and experimental work that we are going ahead and making several full-size installations.

The installations, as shown in Figs. 4 and 5 as well as the new arrangements, are covered by numerous United States and foreign patents, issued and pending.

So far, this paper has covered the make-up and thought behind this development. Now, the best way to measure its effect or to put a yardstick on it, so to speak, is to give the customer's reaction. From experience gained at the Port Angeles installation, the management feels that newsprint mills will be benefited in the following ways:

1. By the installation of suction pickup on an existing machine, it would be possible to increase the production approximately 35%.
2. Provide a grade of paper with much better printing characteristics because of an increased use of groundwood pulp with the consequent reduction in the use of chemical pulp.
3. Reduce breaks on the machine by at least 75%.
4. Reduce the chemical pulp in the sheet from around 20% to around 10%.
5. Help the mill in forestry conservation programs as it is possible to get 10 to 15% more paper with the same amount of pulpwood due to the greater shrinkage in the manufacture of chemical pulp than groundwood.

Received Feb. 13, 1953. Presented at the 38th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 16-19, 1953.

Some Notes on Current Recausticizing Practice

D. C. GILLESPIE

In a recent field survey, pulp mill superintendents and operators in 29 southeastern mills reported over-all operation of continuous recausticizing systems to be good but listed three specific phases, the slaking operation, diaphragm pump maintenance, and scaling of lines, as needing additional attention. Procedures for improving operations in these areas are suggested. A new, simplified design for "unit type" green liquor clarifiers and dregs washers has given improved performance over tray types in initial tests. Two variations of the standard recausticizing flowsheet are described: two-stage slaking and two-stage causticizing, both of which have recently gone into operation in eastern mills. Main advantage of two-stage slaking is improved hot lime handling; of two-stage causticizing, higher causticizing efficiencies.

One of the primary concerns of the pulp mill superintendent is the production of uniform cooking liquor of the strength, clarity, and quantity required in his particular mill. This concern is also shared by the caustic room operator who has the direct responsibility of operating his equipment so that daily demands for white liquor are met. The chain of responsibility does not stop there, however, but extends one more link—to those who are concerned with the design and manufacture of recausticizing equipment.

To obtain a more complete picture of operating problems in cooking liquor production, The Dorr Co., during the months of February through April of this year, conducted a field survey of continuous recausticizing systems in 29 southeastern mills. Through the cooperation of mill managers, conferences were arranged with pulp mill superintendents, operators, and, in some mills, maintenance men. During open discussions on current recausticizing practice and equipment design, numerous suggestions were made and ideas exchanged, all aimed at the common objective of improved performance.

The purpose of this article, therefore, is twofold: (1) to present data and information collected during the survey which might prove useful to superintendents and operators; and (2) to describe several recent developments in equipment and process design which have given improved operation. Although generally considered to be part of the recausticizing system, the lime kiln and its operation are not included in this discussion.

D. C. Gillespie, Chemical Engineer, The Dorr Co., Stamford, Conn.

CHEMICAL DATA

Starting with the survey, over-all operations were reported to be good with most recausticizing rooms producing substantially uniform cooking liquor of desired strength and clarity. In Table I is shown a composite white liquor analysis prepared by averaging data from the 27 kraft mills visited. Since monthly averages were reported by most mills, these data provide a fairly accurate picture of kraft cooking liquor strengths in use at the time of the survey. Average data on lime make-up and production are listed in Table II.

In attempting to compare the extent to which the causticizing reaction has gone to completion in various systems, it should be noted that the causticizing efficiency figure cannot be used unless it is referred to the equilibrium causticizing efficiency. While this figure is best determined experimentally, an approximate value may be calculated by using an empirical mathematical expression derived by Hughey, Herndon, and Withrow (*1*).

Table I. Chemical Analyses of Cooking Liquors Reported by 27 Kraft Mills (Using TAPPI Standard Terms)

Analysis of white liquor	*Range*	*Average*
Total titratable alkali, lb./cu. ft. as Na_2O	5.84–8.52	7.58
Sodium hydroxide, lb./cu. ft. as Na_2O	3.53–5.23	4.54
Sodium carbonate, lb./cu. ft. as Na_2O	0.64–1.72	1.19
Sodium sulphide, lb./cu. ft. as Na_2O	1.17–2.73	1.85
Activity, %	81.6–89.7	84.2
Sulphidity, %	16.0–37.5	24.4
Causticity, %	50.5–68.0	60.0
Causticizing efficiency, %	75.0–86.5	79.3

When this is done, comparison of actual with equilibrium causticizing efficiencies reveals that the 27 kraft mills surveyed were operating an average of 7.2 percentage points below their equilibrium causticizing efficiency, the range being 1.5 to 11 percentage points. Sufficient data are not available to determine the causes for the wide variation in efficiencies among these mills but dilution and temperature in the slaker, availability of reburned lime, degree of agitation, and particularly the amount of excess lime, are all contributing factors.

Turning now to the conferences, the three most frequently mentioned operating problems were the slaking operation, maintenance of diaphragm pumps, and scaling of lines. Some of the suggested methods for smoothing out rough spots in these areas are covered below. While many of the points discussed may seem relatively minor in nature, to the operator trying to keep in production they sometimes take on Gargantuan proportions.

SLAKING OPERATION

Because of the large number of variables involved, the slaking operation requires close control if optimum reaction conditions are to be attained. In this crucial step is determined not only the extent to which the recausticizing reaction will go to completion, but also the particle size of the calcium carbonate which, in turn, affects the subsequent operations of settling, washing, dewatering, and calcining. Contributing to the difficulty of obtaining ideal slaking conditions is the fact that the operator has direct control of only the *quantity* of reburned lime, new lime, and green liquor entering the slaker and not the *quality*. For the latter he is, of course, dependent on the kiln operator, the purchasing agent, and the recovery room operator, respectively. The need for good teamwork in this operation is readily apparent.

In spite of the variety of factors which are capable of upsetting slaking conditions, many operators have acquired a definite "feel" for the operation which enables them to make necessary adjustments when, for instance, the reburned lime is slightly overburned or the green liquor test falls off. Other operators are still developing this skill. Perhaps some of the operating hints listed below will be of help. Most of the suggestions apply only to operation of the combination slaker-classifier.

Operating Suggestions

Protection Against Oversize. Most operators agree that lumps of over or under-burned lime larger than about 2 in. in diameter are easier to handle outside the slaker than in it. A protective grid with 2 by 3-in. openings is recommended either at kiln or entrance to bin. Where constant difficulty with oversize is encountered, the installation of a crusher might be considered.

Slaking Temperature. A few mills were slaking at temperatures as low as 180°F. If rapid slaking and a fast-settling mud are to be obtained, the slaking temperature should be kept just below boiling or around 210 to 215°F.

Improperly Burned Lime. During periods when reburned lime is over or under-burned, some additional detention time in the slaker can be obtained by sending part of the green liquor directly to the first causticizer.

Table II. New and Reburned Lime Data Reported by 25 Kraft Mills

	Range	*Average*
Reburned lime production, lb./ton pulp	328–544	440
Reburned lime availability, %	79–93	86
Kiln efficiency, million B.t.u./ton lime	8.9–20	14
New lime make-up, lb./ton pulp	18–100	51

The lower liquor-lime ratio in the slaker also promotes rapid reaction rates.

Grit Removal. In several mills, packing of grit behind the lowest rake blade of the classifier caused damage to blades and eccentrics. Injecting a small amount of steam at the build-up point prevents this.

Loss of Capacity. Discharge ports between slaker and classifier compartments should be kept clean by periodic rodding to prevent reduction of through-put.

Stack Plugging. Study of this annoying occurrence is still going on but no complete solution has been found so far. Frequent hosing and pounding are the most common methods of attack.

Liner Wear. White iron liner service in mills surveyed averaged two to three years. In a few mills, however, the identical type of liner lasted only 6 to 8 months, reasons still largely unknown. This problem is also being investigated.

PUMP MAINTENANCE

The maintenance of pumps in the recausticizing process was listed by many operators as their most annoying problem. This might well be expected considering that fairly heavy slurries containing corrosive liquor must be handled, some at near-boiling temperatures.

Through the use of special steels, the maintenance requirements due to corrosion in both centrifugal and V-type diaphragm pumps have been substantially reduced. In many mills, however, the V-type pump required additional attention due to frequent rupture of the rubber diaphragms. Reports on diaphragm life varied from several days to over a year but the average seemed to be about 6 weeks.

An examination of broken diaphragms during the survey revealed that two distinct types of failure occur: one consists of cracks at the point of flexion caused partly by fatigue and partly by brittleness brought on, it is believed, by heat; the second type is a definite cutting near the neck of the diaphragm by the plunger plate, the edge of which has become knifelike due to corrosion. The latter condition has been observed most frequently on pumps handling white liquor clarifier underflow.

Both conditions can be (and in some mills are being) alleviated by two simple procedures:

1. *Cooling of diaphragms by covering with water.* This also protects them from grease and oil from overfilled lubrication fittings. Although this procedure seems to be generally known and has been used in some mills for several years, it is still not widely practiced. The survey revealed that diaphragm life is increased at least two to three times by this method. Its use is strongly recommended.
2. *Close examination of diaphragm plunger for sharp*

edges each time the diaphragm is changed. Rounding off such edges will prevent unnecessary cutting around the diaphragm neck.

Another important factor in obtaining longer life is diaphragm composition. Although Neoprene and natural rubber are the preferred materials, supply shortages occasionally necessitate the use of Buna S. However, because of its better performance at high temperatures and its resistance to oil and grease, Neoprene should be specified and used whenever possible.

SCALING OF LINES

The third most frequently discussed operating problem was line scaling. Here, again, due to "the nature of the beast," little hope can be offered for eliminating the tendency of carbonate liquors or partially causticized slurry to build-up on pipe walls. The best answer seems to be to design piping and equipment to facilitate frequent cleaning.

For certain critical sections of the system the installation of alternate lines was suggested. Specifically recommended for duplication were (1) the line carrying raw green liquor from dissolving tanks to clarifier or storage, and (2) the line carrying causticized slurry from causticizers to white liquor clarifier (or slaker to causticizers if the causticizers are elevated). Such an arrangement prevents prolonged shutdowns in case of plugging and permits reaming of plugged line while alternate is in use.

On clarifiers and washers, build-up in feed and overflow lines reduces capacity and adversely affects performance. Completely plugged lines on lower trays of white liquor clarifiers and lime mud washers may lead to serious damage by corrosion, especially if air vents are also blocked. Convincing evidence of this was seen at one mill where the tray in a two-compartment white liquor clarifier was corroded through in almost every segment due, apparently, to prolonged operation with blocked air vents and overflow pipes. Feed to the compartment brought in air which became trapped under the tray while the liquor short-circuited up through the boot.

Several mills are now successfully combating the scaling problem through the use of a special reaming tool which can be snaked through lines while still in place. By following a routine cleaning schedule, both scaling and plugging can be eliminated throughout the entire system. In addition to preventing occasional unexpected shutdowns, cleaning of lines on clarifiers and washers every 2 to 4 weeks permits these units to operate at top efficiency at all times. This method seems to be the best answer to date to the scaling problem.

Thus far, our discussion of the continuous system has been concerned only with operating problems, many of which have been offset through the ingenuity of the operator. At the same time, improvements in the overall process are being developed through simplification of equipment and modification of established procedures. Three such developments will now be described.

NEW DESIGNS

Studies of green liquor clarification made in 1950 revealed a considerable change had taken place in both the quantity and quality of dregs since the tray-type green liquor clarifier was first introduced. Whereas earlier rotary furnaces produced 50 to 75 lb. of heavy dregs per ton of pulp, modern spray-type furnaces now yield on the same basis only 5 to 10 lb. of light slow-settling material. Operators have seen evidence of this change in the increasing difficulty of keeping boots sealed to maintain balanced operation on their green liquor clarifiers.

As a result of these studies and subsequent development work, a new "unit type" green liquor clarifier has been designed which provides increased clarification depth to handle the light dregs and a drastically simplified piping system.

As shown in Fig. 1, the new design consists simply of a tank with a deep, central feedwell and a raking mechanism. Raw green liquor enters the feedwell tangentially at a point just below the solution level. The swirling motion imparted to the feed promotes flocculation of green liquor dregs as they travel downward in the deep feedwell. The submerged feeding eliminates unnecessary aeration which may cause foaming. Clarified effluent is collected in a peripheral launder and taken off at a single point while thickened dregs are raked to a central discharge cone and pumped to the dregs washer in the conventional manner.

Because of the simplicity of the design, operating attention has been reduced to a negligible point since there are no seals to maintain and, hence, no overflow sleeves to adjust. Only three pipes are needed: feed, overflow, and underflow, all of which can be installed to facilitate cleaning or replacement. This simplified design reduces very substantially the capital cost of the installation.

The new unit described above was first tested in a southeastern mill where a tray-type green liquor clarifier and dregs washer were converted by removing trays and installing a deep feedwell. Initial reports on the overflow clarities show results equal to or better than those obtained with the former design.

The unit type design has been similarly applied to

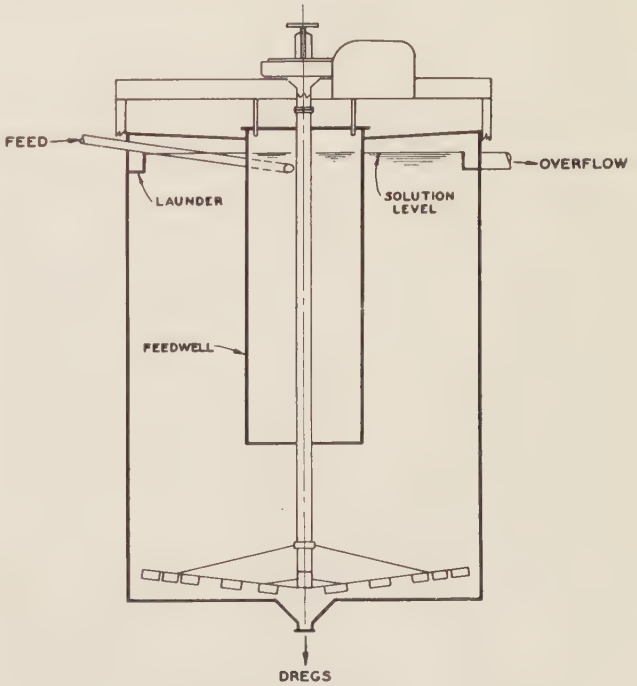

Fig. 1. Unit type green liquor clarifier

the dregs washer with corresponding advantages. Greater control over soda losses in the dregs is made possible by re-using dregs washer effluent as wash water in the two-stage lime mud washer. With such an arrangement, the amount of fresh wash water used at the dregs washer is no longer limited to about 15% of the total available, but can be increased to give better washing (25 to 30% of the total is considered reasonable). Since the total amount entering the system must be kept constant, any increase needed at the dregs washer is compensated for by a decrease in the amount of fresh water entering at the mud washer.

Recommended for green liquor clarifier–dregs washer systems is the use of electric timers to regulate underflow pumping. Since few mills have a sufficient quantity of dregs to warrant continuous operation, the pumps are usually turned on by the operator for about 40 to 50 min. per shift. In some mills he simply pumps until the underflow "gets thin," which is often as little as 5% solids. By installing a timer on each pump and experimenting to establish the proper cycle (found to be 6 min. out of every hour at one mill), the underflow is always pumped at high density (15 to 20% solids), thereby appreciably reducing the soda loss in the discarded dregs. A second advantage is that the operation becomes completely automatic and requires little operator attention.

TWO-STAGE SLAKING

A discussion of current developments would not be complete without mention of several optional variations of the standard flowsheet recently incorporated in existing mills. One such is two-stage slaking, which is simply a different approach to the old problem of hot lime handling.

As shown in Fig. 2, reburned lime is discharged directly from the kiln into a relatively large agitated tank called the *primary* slaker which overflows by gravity to a combination slaker-classifier. Here make-up lime is

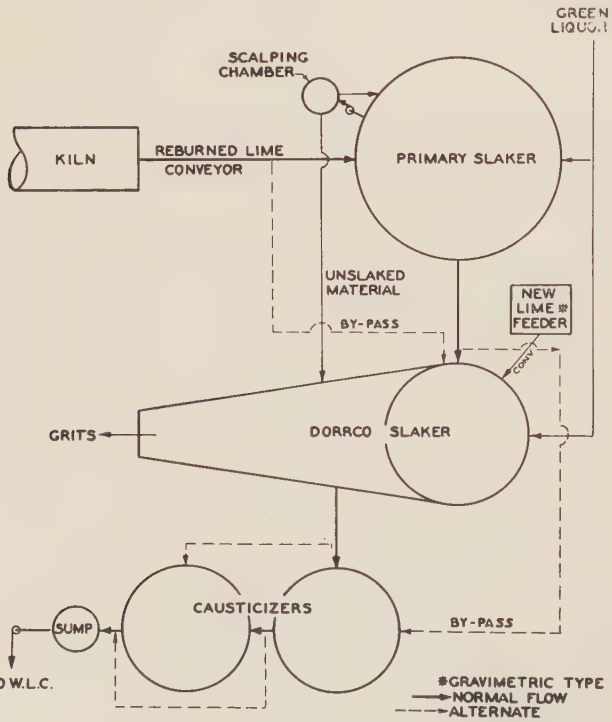

Fig. 2. Two-stage slaking system

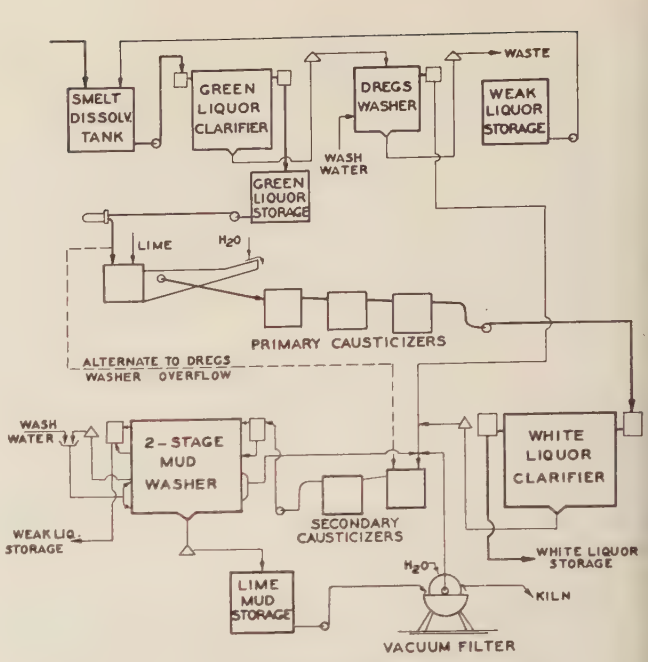

Fig. 3. Flowsheet of two-stage causticizing

added through a gravimetric feeder and unslaked material is raked out by the classifier. The primary is protected from oversize by a perforated, preferably stainless steel, feed basket, the lower portion of which is submerged in the slurry. The basket provides additional slaking time for lime lumps and retains any coarse unslakable material which can then be raked out of the basket manually as necessary. Any build-up of unslaked particles in the bottom of the primary may be removed by pumping intermittently to a small scalping chamber where a rough classification takes place, larger particles going to the classifier for removal and thin slurry returning to the primary. By adding make-up lime through a gravimetric-type feeder, close control over the per cent free lime in the lime mud can be maintained.

From an equipment standpoint, the system eliminates the need for a green liquor heater, hot lime elevator, reburned lime bin, chain feeder, and screw conveyor, substituting for them an inclined apron conveyor, large primary slaker, and gravimetric feeder. The primary is designed large enough to provide about 2 hr. detention, thus serving to even out kiln surges and, at the same time, to get maximum utilization of the lime.

The main disadvantage of the setup is the lack of holding capacity between the kiln and causticizers in case it becomes necessary to shut down one of the slakers. This can be overcome to a great extent through the use of the by-passes shown in Fig. 2.

The two-stage slaking system is now in successful operation in S. D. Warren Co.'s mill at Cumberland Mills, Me., and is being incorporated into three other recausticizing systems now under construction.

TWO-STAGE CAUSTICIZING

The second variation of the standard flowsheet, two-stage causticizing, has been used for years in both Canadian and European mills. It is of interest now because of its recent incorporation in the expansion program of a southeastern mill.

The system takes advantage of the fact that the causticizing reaction can be driven further toward its

uilibrium point by causticizing in the presence of ex-ss lime. After the strong white liquor is decanted in e clarifier, the lime mud, containing well over the ıal 2 to 3% free CaO, is sent to secondary caustiers where the excess is reacted with either strong green uor or weak carbonate effluent from the dregs washer e Fig. 3). Using dregs washer overflow, a recent invation, has an added advantage in that causticization a solution dilute with respect to sodium compounds sults in a higher per cent conversion (*2*).

A two-stage causticizing system recently went into eration at West Virginia Pulp and Paper Co.'s Cogton, Va., mill. Results after 2 weeks' operation ow causticizing efficiencies less than 1.0 percentage nt below the equilibrium causticizing efficiency for ir liquor. Similarly, several Canadian mills using s principle have reported efficiencies within 0.6 to 1.1 rcentage points of equilibrium with excess free lime er secondary causticizing as low as 0.4%.

To summarize briefly, it is clear from this limited discussion covering only points of current interest that the st effective operation of the caustic room is not holly a matter of established operating routine. here will always be trouble spots in equipment operaon, often minor in nature, but just as capable of snarig production as a major breakdown. They are just much the responsibility of the equipment manuturers as of the pulp mill superintendent and his aff. Only by close cooperation between them can ractical solutions to such problems be found.

It is, of course, always the responsibility of the manucturer to constantly modify and improve his equipent and process to better handle the problems of the dustry he serves. Here, too, the cooperation of the ser is absolutely essential to practical improvement. his essential cooperation is well exemplified by the maerial presented here. Without the help and openmindedness of the staffs of those mills covered in the survey, no clear-cut picture of day-to-day operating problems could have been drawn. By the same token, every major equipment or process change initiated must always have the benefit of the practical operating viewpoint before its merit can be realistically appraised.

LITERATURE CITED

1. Hughey, G. B., Herndon, L. K., and Withrow, J. R., *Paper Trade J.* 114, No. 9: 25–32 (Feb. 26, 1942).
2. Knight, C. H., U. S. pat. 2,552,183 (May 8, 1951).

Mills Participating in Survey

Brown Paper Mill Co., Inc., Monroe, La.
Brunswick Pulp and Paper Co., Brunswick, Ga.
Champion Paper and Fibre Co., Canton, N. C.
Container Corp. of America, Fernandina, Fla.
Coosa River Newsprint Co., Coosa Pines, Ala.
Crossett Paper Mills, Crossett, Ark.
Gaylord Container Corp., Bogalusa, La.
Gulf States Paper Corp., Tuscaloosa, Ala.
Halifax Paper Co., Roanoke Rapids, N. C.
Hollingsworth and Whitney Co., Mobile, Ala.
Hudson Pulp and Paper Corp., Palatka, Fla.
International Paper Co., Bastrop, La.
International Paper Co., Mobile, Ala.
International Paper Co., Moss Point, Miss.
International Paper Co., Natchez, Miss.
International Paper Co., Panama City, Fla.
International Paper Co., Springhill, La.
Macon Kraft Co., Macon, Ga.
Mead Corp., Kingsport, Tenn.
National Container Corp., Jacksonville, Fla.
North Carolina Pulp Co., Plymouth, N. C.
Riegel-Carolina Corp., Acme, N. C.
St. Joe Paper Co., Port St. Joe, Fla.
St. Marys Kraft Corp., St. Marys, Ga.
St. Regis Paper Co., Mill No. 1, Pensacola, Fla.
St. Regis Paper Co., Mill No. 2, Pensacola, Fla.
Southern Paperboard Corp., Savannah, Ga.
Union Bag and Paper Corp., Savannah, Ga.
West Virginia Pulp and Paper Co., Charleston, S. C.

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Sulphate Formation in Sulphite Pulping

M. S. ANDERSON and G. S. McKNIGHT, JR.

tudies of sulphate formation made in a sulphite mill perating on calcium-base liquors made from kraft sludge ıow that the resulting sulphur loss may be of the order f 44 lb. per ton of bleached pulp. The majority of the sulhate formation occurs during the cooking process, and ıe catalytic effect of colloidal sulphur is believed to be esponsible for about 40% of this formation. Serious scale eposition in the digester circulation lines was eliminated y a change from steam injection devices to bottom steamıg. Conversion to sodium-base acid reduced sulphate ormation by about 68%.

The history of the sulphite process from its beinning has been a continuous battle to prevent the eposition of calcium sulphate. Most mills have dapted their operation so that they are able to live ith this problem. Modern improvements such as the se of circulating systems, indirect heating, and the evaporation and burning of waste liquor have once more made the problem of sulphate formation one of primary importance in sulphite operations.

Many investigators have studied the instability of sulphite cooking acids. The mechanism of conversion of sulphur dioxide to sulphur trioxide was first studied by Foerster (*1*). Klason (*2*) first recognized the catalytic effect of colloidal sulphur, selenium, and sugars. Further investigation of the effect of selenium was made by Hagglund (*3*) who proved that there are unknown substances produced in sulphite cooking which contribute to the formation of sulphates in the digester. He found cymene had no effect, but that high concentrations of turpentine were detrimental. Formic acid, which is formed during the sulphite cooking process, has recently been studied by Stockman (*4*) who came to the conclusion that, under normal cooking conditions, the effect was not serious. While the literature covers the outcome of extensive laboratory studies of this

. S. Anderson and G. S. McKnight, Jr., Oxford Paper Co., Rumford, fe.

problem, the information available on actual mill experience is rather meager.

With the installation of circulating systems on the digesters in this mill, a scaling problem of considerable magnitude developed. Continual maintenance was required to keep the circulation lines free of calcium sulphate deposits, while pulp quality and production suffered during periods when the circulation lines were blanked off. Analysis of the deposits in the circulation lines, digester strainers, and acid towers showed that the scale consisted of over 90% calcium sulphate. Attempts to remove the scale by chemical methods proved impractical from an operating viewpoint. Studies were undertaken to determine the origin of the calcium sulphate and some of the factors involved in its formation. Although the studies have not been completed it is the purpose of this paper to report the interpretations of the findings to date.

MILL TRIALS

As a result of literature surveys, operating experience and technical studies, a series of mill trials was made in an effort to bring the scaling problem under control.

Effect of Dolomitic Lime

In this mill, calcium carbonate sludge from the kraft process is used in the manufacture of sulphite acid. Since most mills equipped with Barker acid towers use dolomitic lime, it was decided to make a mill trial using this lime in the hope that the more soluble magnesium sulphate would be formed, minimizing the scaling problem. After a month of operation on high magnesium lime, no noticeable effect on the rate of deposition of calcium sulphate was observed.

Sequestering Agents

Samuelson's (*5*) studies indicated that the greater portion of the sulphate was formed toward the end of the cooking cycle. As a result of conversations with a manufacturer of complex phosphates, it was felt that the stability of these compounds was such that, if introduced during the latter part of the cook, their sequestering action might reduce the deposition of the calcium sulphate. A trial was made in which sodium hexametaphosphate was added to the digesters during the cooking process at a rate sufficient to maintain a concentration of 3 p.p.m. While the rate of deposition was reduced it was not sufficient to merit its adoption as standard procedure.

Effect of Free Sulphur Dioxide

The possibility of retarding the decomposition of sulphite acid by maintaining high acidity as suggested by Foerster (*1*), coupled with the observation that the scaling probelm was somewhat less during periods of high acid concentrations, led to a mill trial in which the free sulphur dioxide was increased from 5 to 8% by means of liquid sulphur dioxide. This procedure, while it did not eliminate the problem, reduced the rate of deposition to such an extent that, in spite of the high cost of sulphur dioxide, it was continued until more satisfactory methods were found.

Effect of Steam Injection Devices

Since the principal operating difficulty came from scale deposited in the circulation lines after the steam injector, it was felt that in this particular installation, where steam of 50° of superheat was used, localized overheating caused the deposition of calcium sulphate due to its decreasing solubility with increasing temperature. Because saturated steam was not available the use of the injectors was discontinued, while at the same time the circulating systems were maintained in operation. After this step was taken there was no deposition in this location. Since then, Wilcox (*6*) has reported that in one mill there are definite indications that steam injectors increase scale formation.

RESEARCH STUDIES

The initial investigations showed that the majority of the sulphate formation was due to colloidal sulphur, air, and elevated temperature. The investigations so far have been limited to these factors to the exclusion of substances formed during the cooking process. The program of investigation was divided into two sections: one, a study of actual sulphate balances existing in the sulphite mill under normal operating conditions, and two, a laboratory study of the catalytic effect of colloidal sulphur on sulphite acid decomposition, which was done by The Institute of Paper Chemistry at Appleton, Wis.

Sulphate Balances

A series of soluble sulphate balances from the burner gas through to the final blow liquor under normal operating conditions was made. The average results of these surveys are given in Table I. The burner gases were tested for sulphur trioxide by the brucine hydrochloride method and sulphate determinations were made by TAPPI Standard T 629 m-48.

In all cases, samples were composited where possible. In the cold acid system, concentration of the calcium sulphate was below the saturation point, and therefore, the test results show the total sulphate formation. However, in the hot acid system, it was impossible to measure the amount of sulphate deposited, and the test results, therefore, represent only the soluble portion remaining in the liquid.

Institute of Paper Chemistry Studies

It can be seen from Table I that considerable quantities of sulphur trioxide are formed in the hot acid system, particularly in the digesters. Klason (*2*) states that 0.5 p.p.m. of selenium or 250 p.p.m. of colloidal sulphur would be sufficient to precipitate as sulphate all of the calcium present in the digester. Analysis of the sulphur proved that no selenium was present. While the testing difficulties involved prevented the determi-

Table I. Sulphate Distribution

Test point	*Concentration of SO_3 expressed as pounds of $CaSO_4 \cdot 2H_2O$ per ton of air-dry bleached pulp*
1. Hot burner gas	21
2. Cold burner gas	12
3. Leaving barker towers	27
4. Entering accumulator	33
5. Entering digesters	57
6. Side relief	18
7. Discharged in blow	69

ble II. Effect of Colloidal Sulphur Concentration on Sulphate Formation

Source	*Colloidal sulphur, p.p.m.*	*$CaSO_4 \cdot 2H_2O$, g./l.*
Raw Acid	..	5.33
Acid After Cooking	0.0	12.27
	1.7	14.12
	2.7	15.34
	3.3	15.42
	5.0	15.90
	8.3	16.82
	11.7	17.76
	31.7	18.89

tion of the amount of colloidal sulphur present in the stem, the kraft mill sludge used in this mill for manuturing sulphite acid contained sufficient residual sulde to precipitate on treatment with sulphur dioxide proximately 5 p.p.m. of colloidal sulphur. As a reit, it was decided to have The Institute of Paper Chemry investigate the magnitude of the effect of colloidal phur on sulphate formation under digester conditns. The results of their studies are given in able II.

In this study the colloidal sulphur was prepared by lution of alcoholic solutions of sulphur with raw sulhite acid. It is possible that this sulphur dispersion iffers from that present in mill sulphite cooking acid, nd this could possibly affect its catalytic action.

A study of Table II shows that at a colloidal sulphur oncentration of 5 p.p.m., approximately 40% of the ulphate formed in the digester is attributable to colidal sulphur, while 60% is a result of the combined ffect of air and high temperature. It was considered hat sulphate formation as found by the Institute corected to conditions existing in this mill was more repesentative of the actual formation than that shown by he mill tests in Table I, since it accounted for the arge deposition of calcium sulphate taking place in the igesters.

Table III has been constructed from the data in ables I and II, using 5 p.p.m. for the concentration of olloidal sulphur in the cooking acid.

DISCUSSION

Table III shows the sources of formation of calcium ulphate and its accompanying sulphur loss. Some of he possible errors in this study have been mentioned, uch as the form of the colloidal sulphur used in the nstitute study, the adaptation of the Institute reults to operating conditions, and the impossibility of etermining the amount of sulphate deposited in the hot cid system. In addition, only that colloidal sulphur hich occurs from the reaction of sulphur dioxide on he sulphides in the kraft sludge was used, neglecting he sublimed sulphur from the burner, and possible sulphur formed as a decomposition product during the cooking process. By neglecting these sources of colloidal sulphur, it is apparent that the sulphur loss of 44 lb. per ton was a minimum figure.

Table III. Sulphate Formation

Source of formation	*Pounds per ton of air-dry bleached pulp*		
	$CaSO_4 \cdot 2H_2O$	*Sulphur*	*Percent*
Raw Acid System			
1. Burner gas	21	4	9
2. Barker towers	15	3	7
3. Storage	6	1	2
Hot Acid System			
1. Accumulator	6	1	2
2. Digesters	189	35	80
Total	237	44	100

The formation of calcium sulphate in the acid towers and the raw acid system was attributed to oxidation of the sulphurous acid due to the presence of air. It has recently been pointed out by Hagglund (*7*) that the addition of as little as 5% sulphite waste liquor to the water used for acid making will result in a reduction of approximately 80% of the sulphates formed by oxidation. It is planned to evaluate this suggestion in a mill trial.

The sulphur loss occurring in the digesters amounts to 80% of the total sulphur loss due to the formation of sulphates. The Institute studies indicate that about 60% was caused by the combined effect of air and high temperature. Limited experiments in pre-steaming showed that the major portion of this was caused by the presence of air in the digester.

Although the operating difficulties due to scaling were brought under control by steaming through the bottom cross, the actual problem of obtaining the benefits of steaming through the steam injectors without scale formation was not realized until the current conversion to sodium base. This process change and accompanying equipment modifications have considerably reduced air leakage in the raw acid system and eliminated the colloidal sulphur previously formed from the kraft mill sludge. In addition, digester cooking time has been shortened and the maximum cooking temperature has been reduced. Applying the knowledge gained in the sulphate studies, it was calculated that the combined effect of these changes would reduce the sulphur loss due to sulphate formation by approximately 42%. Hagglund (*8*) shows graphically that there is a further reduction even under the same cooking conditions attributable to the change from calcium to sodium base. Under conditions of operation in this mill, this would increase the expected reduction in sulphate formation to approximately 65%.

Operation on soluble base makes possible a more quantitative evaluation of sulphate formation since no insoluble sulphates are formed. Preliminary testing shows a reduction in sulphate formation of about 68% which compares favorably with the calculated value.

Although the use of soluble base eliminates the scaling problem, the loss of sulphur due to the formation of sulphates is still of considerable importance. As soon as the method of operation under soluble base becomes stabilized, it is planned to make more extensive mill studies than were possible under calcium-base operation.

LITERATURE CITED

1. Foerster, F. Z., *Anorg. U. Allgem. Chem.* 128: 245 (1923).
2. Klason, P., *Arkiv. Kemi, Mineral. Geol.* 4, No. 1 (1910).
3. Hagglund, E., Backstrom, C. H., Karanovic, M., Runquist, L., and Vincent, O., *Svensk Papperstidn.* 38: 659–695 (1935).
4. Stockman, L., *Svensk Papperstidn.* 54: 621–627 (1951).
5. Samuelson, O., *Svensk Papperstidn.* 49: 575 (1947).
6. Wilcox, J. M., *Tappi*, 33, No. 6: 272–275 (1950).
7. Hagglund, E., *Svensk Papperstidn.* 49: 191 (1946).
8. Hagglund, E., "Chemistry of Wood," pages 427–428, New York, N. Y., Academic Press Inc., 1951.

Received Jan. 22, 1952. Presented at the 37th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 19–21, 1952.

Abatement of Sulphate Pulp Mill Malodors by Odor Masking Agents

WALTER C. MEULY and BRECKINRIDGE K. TREMAINE

A method for air-borne kraft mill odor abatement is described which consists of masking the principal kraft mill malodors (volatile sulphur compounds) by means of odor masking agents introduced into the digesters and released simultaneously with the malodors throughout the kraft process. The modified kraft odors are less intense and less offensive. The simplicity of application, masking power at very high dilution, and pervasiveness are discussed. Laboratory studies and extensive field tests are described. An attempt at a rational explanation of odor masking has been made based on semiquantitative odorimetric measurements of odor quantities and degree of masking. For this purpose, the values of scent unit (*SU*), scent value (*SV*), gram scent value (*GSV*), mask unit (*MU*), mask value (*MV*), and masking ratio (*MR*) have been introduced and defined. It is shown that these values and measurements permit an estimate of kraft mill odors and of quantities of masking agents required; laboratory results have been supported by literature and field data.

THE problem of malodors associated with sulphate pulping has grown in proportion to the rapid expansion of the sulphate pulping industry. The proposals for the elimination or abatement of offensive odors occupy a prominent part in today's literature, which testifies to the vast social and economic importance of this aspect of pulp manufacture. The remark by E. Hagglund (*1*) "The growth of the sulphate pulp industry has been retarded materially owing to the inability of the manufacturer to eliminate or to reduce the presence of undesirable odors in the mill and its surroundings" is more timely today than when it was made in 1926. Considerations of odor pollution, especially the air-borne type, must have ruled out many an otherwise attractive plant location.

PROPOSALS FOR ODOR ABATEMENT

This paper is concerned primarily with air-borne kraft mill odors. The voluminous literature dealing with the ways and means to decrease the air-borne odor pollution indicates that the remedial measures proposed so far have one feature in common: they all depend on removing or destroying the odors at a definite point of treatment by physical (e.g., scrubbing; adsorption) or chemical (e.g., oxidation; chlorination; burning) means or combinations of both. The high capital investment involved in collecting the odors at one point or of treating at a number of separate points sharply limits the practical application of these remedies, particularly in existing paper mills. Dexter (*2*) in a summary of methods for the elimination of kraft mill odors estimates in 1949 that the cost of odor elimination by means of chlorine may well be $10 per ton of paper. Hisey (*3*) in 1951 describes the advanced design of a plant at Johannesburg, S. A., which is said to achieve a large measure of mill odor abatement by an elaborate system of collecting, scrubbing, air oxidizing, chlorinating, and burning of offensive gases. It is evident that such advanced design can only be incorporated into a new installation and that the added cost of equipment and operation may well impair the competitive position against a conventional mill, especially so since the saving on sodium sulphate is small at a reported make-up of 100 to 150 lb. sodium sulphate per ton of pulp.

A particularly successful method of partial odor elimination is the passage of the flue gases through electrical precipitators where discrete particles are retained as well as a portion of malodors adsorbed thereon. More recently the air-oxidative fixation of black liquor by Bergstrom, Tomlinson, and others is being studied on a plant scale and may lead to partial odor abatement, provided the spent air is itself treated before being released. The elimination of noncondensable gases from the digester relief by burning them under a boiler or in a furnace is attractive because these gases constitute a localized high concentration of malodor (calculations based on data from Bergstrom and Trobeck (*4*) show that noncondensed gases contain 8% by weight methyl mercaptan and dimethyl sulphide). The desirability of destroying these malodors by burning was stressed by Dalla Valle (*5*) in 1939 in his pioneering work on the evaluation of odor nuisance in kraft mills and we recommend this method for more general application.

ODOR ABATEMENT BY ODOR MASKING

Our approach to air-borne odor abatement, which we believe to be novel, consists of superimposing a more pleasant odor upon the mill odors and thus masking their offensive nature, by the addition of suitable odoriferous compounds to the digester charge prior to the cook. This method of odor abatement has one unique advantage over the other methods: the remedy is as all-pervasive as the malodors themselves. Being incorporated from the beginning, it follows the malodorous liquids with the process throughout the plant and wherever malodor escapes into the air, there is present a modicum of masking odor to escape into the air with it.

It is evident that in order to perform this work, an odorant must have chemical stability to resist the severe conditions of the mill operations, especially in the digester, and this requirement imposes a considerable restriction upon the number of useful chemicals; it also

WALTER C. MEULY, Research Associate and BRECKINRIDGE K. TREMAINE, Technical Representative, Organic Chemicals Dept., E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

ist have proper and graduated volatility to complete travel through the operations; it must have odor ality suitable for masking the mill odors. Most im- rtant, it must have, at economical low concentra- ns, sufficient odor strength to modify noticeably the lodors present.

The requirement, born of economic necessity, to work h extremely low concentrations of odorants, at a el of say 0.002% based on the digester content, ought about our present investigation of odor meas- ment and of odor masking. A rational approach to ft mill odor masking requires measurement of rel- ve odor quantities because the problem, in its sim- st terms, resolves itself into these three questions:

. How much malodor is involved in the air-borne kraft mill rs?

2. How much odor is introduced by the masking agent?

3. What is the ratio of masking odor to mill odor at which ceable abatement of malodors may be achieved?

ODOR MEASUREMENT

Odor measurements in absolute terms are not possible, ause, whether simple or complicated apparatus is d, odor intensity and quality are estimated ulti- tely by their perception in the human nose. How- er, relative odor strength can be determined. The most tensively used method in odorimetry is the dilution of an, odorless air with an odorous gas or vapor, until e first, often indefinite and vague odor sensation ap- ears. This amount of odor stimulus is called the *inimum perceptible*, or the odor threshold value, and is expressed as the concentration of odorant, prefer- ly in terms of parts per part of air. Tremendous ifferences in concentration between different odorants ist; the multitude of values reported in the literature ay be summarized by stating that there is often good eneral agreement, especially as to relative values for everal odorants, but in a number of instances 10, 100, nd even 1000-fold differences of concentrations have een reported for the same substance. The *differ- ntiation threshold* is the minimum change of concen- ation in air for one substance which can be observed s a perceptible change in odor intensity for that sub- ance. This change averages about 30 to 50% of the itial concentration and on this value most observers e in fairly close agreement. Some observers in special ases range down to 5% and up to 100% (e.g., Barail, . S. Testing Co. (*6*)). In spite of imperfect agree- ent significant conclusions can be drawn in view of e extreme range of intensities under consideration.

We have conducted an extensive odorimetric testing ogram, and for the purpose of air-borne kraft mill dors, we have developed, in preference to the compli- ted air dilution method, a simple method of estimat- g various odors, based on diluting odoriferous sub- ances progressively in pure water and smelling the r space above the solutions contained in partially led glass bottles. This technique corresponds to the ethods used for estimation of odor in drinking water), on the development of which there exists con- derable literature (e.g., Fair and Wells, Spaulding, elbig (*8*, *9*, *10*)). Since all the odors in kraft mills iginate in an aqueous medium we believe that this ethod is suited to and desirable for the problem at nd.

It is not possible here to discuss in detail the effect of experimental variables such as size of sample, volume of air above solution, temperature, solubility factors, aging, requirement of odor-free water, use of coded samples, necessity of frequent reference to standard samples; all of these are among the factors to be reckoned with.

It became apparent that the establishment, by progressive dilution, of the minimum perceptible is subject to great error due to the indefinite nature and faintness of the first perceptible odor stimulation. We have therefore adopted, as the basis for odor measurement, that concentration at which the odor is faintly but distinctly recognizable. This leads to the concept of the *scent unit* or *unity* (*U*), defined as the odor stimulus which is *faintly but distinctly recognizable*. In contrast to the odor threshold value this may be described as the odor *recognition* threshold value. It is expressed as the concentration of odorant, preferably as parts per part of water.

Under our conditions of experimentation the odor recognition threshold (scent unit) lies at a concentration some 10 times higher than the odor threshold in water itself and it is much more easy to establish and duplicate. The consistency of measurement is about the same as claimed in the literature, our differentiation threshold for high dilutions lying at a concentration change of 30%. The probable error for a series of observations with a small panel is about 10%.

The relationship between the concentrations of the same odorant at the minimum perceptible (in air) and the scent unit (in water) is a complex one, because the distribution of odor between water and air in the scent unit determination is not subject to ready calculation. At the extremely low concentrations in question, the odorants usually are present at levels far below their corresponding vapor pressures. These solutions follow Henry's law and the odor concentration in air is proportionate to the concentration in water. The distribution of odorant molecules between water and air, is such that a surprisingly high concentration is contained in the air, as may be seen from a comparison of a few odorants.

Table I. Relationship of Odor Threshold Concentration and Scent Unit Concentration

Odorant	*Literature* (11) *odor threshold concentration, g./g. in air*	*Observed scent unit* (U) *concentration, g./g. in water*
Methanol	800×10^{-6}	500×10^{-6}
Camphor	4×10^{-6}	3×10^{-6}
Coumarin	0.02×10^{-6}	0.4×10^{-6}
Chlorphenol[a]	0.003×10^{-6}	0.03×10^{-6}

[a] Dalla Valle (*5*) quoting from U. S. Bureau of Mines figures states that chlorphenol in air is readily perceptible at 0.15×10^{-6} g./g.

If a camphor solution, diluted to 3 p.p.m. in water, contains the concentration of odorant which causes the stimulus of 1 scent unit, then camphor itself contains the reciprocal number of scent units or $0.33 \times 10^6 =$ 330,000 scent units. Thus the odor content of an odorant may be expressed by the number of scent units which it contains and this value we call the *scent content value* or *scent value* (*SV*). The *SV* of camphor is 330,000.

The term *gram scent value* (*GSV*) relates the inherent odor content (*SV*) to the unit weight of the odorant and

this value permits one to express the relative amount of odor contained in a discrete weight of an odorant. A bottle with 20 grams camphor thus contains locked up a *GSV* of 20 × 330,000 or 6,600,000.

It should be understood that the *SV* of 330,000 for camphor does not imply that camphor itself smells 330,000 times as strong as its solution at 1:330,000. The Fechner-Weber Law of sensory perception is known to apply to odor perception and we have found it to be operative in our technique of odorimetry. This physiological law states that in order to increase odor sensation by equal degrees (increase in arithmetic progression) the stimulus causing the increase of sensation must be varied by a constant fractional increment (increase in geometric progression). For our technique assuming an increment of 50% for the differentiation threshold the odor intensity N of camphor is $(1.5)^N = 330{,}000$. $N = 30\ U$. The odor sensation of camphor itself is thus only about 30 times as strong as that of its solution 1:330,000. (The assumption is made that the odor stimulus of scent unit and of differentiation threshold are similar, which we believe to be the case.)

Thus, in order to determine the total odor content of camphor, or any other odorant, the odorant must first be diluted to the measurable concentration of a scent unit, the reciprocal of which gives its inherent odor content in terms of its scent value.

A few *SV* pertinent to the kraft mill odor problem are listed in Table II; by way of comparison the odor strength of a glass of iced tea corresponds to an *SV* of only 10 to 20.

The *SV* given for black liquor are average values obtained from samples of several mills. The differences between pine black liquors were rather small and fell usually within the limits of accuracy of our determinations. Hardwood black liquor is listed as having twice the *SV* of pine black liquor. Actual *SV* for samples from three mills were 1.8, 2.3, and 2.5 times greater than for pine black liquor. This is an indication that hardwood pulping may present a greater odor problem than does pine.

ESTIMATION OF KRAFT MILL ODORS

With the methods and units of odor measurement developed above, the odor content of air-borne kraft mill odors can be estimated, provided the latter can be subjected to measurement.

There are two approaches which are believed to lead to a reasonably correct estimation, keeping in mind the many variables practiced in the complex pulping operation.

1. Laboratory studies of the pulping operation under simulated plant conditions permit the collection and measurement of the sum of air-borne odors and thus give an estimate of their distribution and quantity. These results can be translated into figures for plant operation and expressed as amounts of odors in *GSV* per ton pulp.

2. The literature contains several studies, utilizing analytical chemical methods, of the amount of volatile sulphur compounds which become air-borne during the pulping operation and which are recognized as the principal cause of the kraft mill malodors. Knowing the quantities liberated per ton of pulp and knowing their *SV*, the amount of malodor in *GSV* can be calculated. We have followed both approaches.

Table II. Scent Values of Major Kraft Mill Odorants

Odorant	*Scent unit* (U), *g./g.*	*Scent value* (SV)
Methyl mercaptan	0.005×10^{-6}	200×10^{6}
Dimethyl sulphide	0.01×10^{-6}	100×10^{6}
Hydrogen sulphide	0.004×10^{-6}	250×10^{6}
Pine black liquor	50×10^{-6}	0.02×10^{6}
Hardwood black liquor	25×10^{-6}	0.04×10^{6}
Masking agent A type	0.03×10^{-6}	33×10^{6}

Laboratory Data on Kraft Mill Odors

Our experimental procedure is based on the following premise: all the kraft mill odor is generated during the cook in the digester and it is all contained in the black liquor at the end of the cook, excepting the noncondensable digester relief gases. Various portions of the malodor (and by no means all that is present potentially) are then released into the atmosphere throughout the process, starting with the digester blowdown and continuing through the various stages of black liquor evaporation to the furnace. Concentration in the laboratory of genuine plant black liquor permits simulating plant conditions at the evaporation stages. Based on our laboratory study of black liquor behavior during concentration, we believe, furthermore, that the results may be extrapolated with a fair degree of accuracy to the digester blowdown stage, which in effect represents a first concentration step of the initial black liquor. Over a wide range of concentrations (from 16 to 64% solids) it was found that on atmospheric distillation the amount of malodor leaving the black liquor was proportional to the amount of water removed. While the digester blowdown is a super-atmospheric distillation it may approach an atmospheric one with respect to release of malodor; for instance, ammonia at 40°C. in water is only about twice as soluble at 75 lb. pressure than it is at atmospheric pressure, and the high digester temperature will decrease the solubility of gases.

In order to estimate the amount of odor leaving the black liquor during its passage through the vacuum evaporators and the cascade evaporators, black liquor was subjected to the conditions prevailing at these operations, and by suitable condensers and traps all the odorous gases were absorbed and their odor content determined.

The procedure is as follows: a measured amount of fresh weak pine black liquor (16% solids, pH 12.0–12.5) obtained from southern kraft mills is concentrated (partially evaporated) under conditions simulating digester blowdown, multiple effect evaporators, and cascade evaporators. (The further stages in the operation such as green liquor, white liquor, and lime kiln operations are of minor importance in the generation of air-borne malodor and were not considered.) The gases and vapors are first condensed in a glass condenser at room temperature and the noncondensed portions are subsequently condensed by means of dry ice and water traps. By transferring all condensates into water and diluting to unity, the *SV* of the condensates is determined. By taking into account the amount of black liquor used, the gram scent value (*GSV*) of the odors having been emitted from 1 gram of black liquor is established. For example, by distilling at ordinary pressure 100 grams black liquor of 16% solids to a solids content of 20% there is collected by the glass condenser

28°C., 19.8 grams highly odorous distillate with $U =$ $\times 10^{-6}$ grams per gram, representing a slightly ronger odor than the original black liquor ($U = 50 \times$ $^{-6}$ grams per gram). The odor content SV is 0.025 $\times 10^6$ and the 19.8 grams distillate contain a GSV of 0.5 $\times 10^6 = 500{,}000$. Since 100 grams black liquor were nployed the odor emission per gram black liquor is $005 \times 10^6 = 5000$ GSV. In addition to the aqueous ondensate, the traps (the last of which is odorless) yield 00 grams of a faintly odorous solution, containing a SV of $0.007 \times 10^6 = 7000$. The amount of odor t retained in the condensate and thus becoming air-rne is only 7000/500,000 or 1.4% of the amount of lor liberated in the concentration step.

With the methods exemplified above, we have ob-ned the following laboratory results and have trans-ed them into mill figures:

Digester Blowdown. It is assumed that the steam re-sed in the blowdown carries a similar amount of odor in an atmospheric distillation of black liquor because, er a wide range of black liquor concentrations, dis-lation carries off similar amounts of odor per pound of stillate. It is recognized that the blowdown is likely carry actually a greater amount of odor. The mount of blowdown flash steam is estimated at 1800 to 400 lb. per ton pulp (10 to 12% by weight of the di-ster charge which weighs 8 to 10 tons per ton pulp (*12*)) V of blowdown steam (condensed as liquid) $= 0.025$ $\times 10^6$. Odor content per ton pulp: $0.025 \times 10^6 \times$ $400 \times 453 = 27{,}000 \times 10^6$ GSV per ton pulp (mini-um). All of this odor becomes air-borne malodor in he mill if no condensation is provided. In turn, if a urface condenser at 28°C. were provided, about 98% f this odor would be retained in the liquid as shown bove. It is believed that many plants provide partial ondensation.

Multiple Effect Evaporators. According to Stephen-on (*12*) with modern multiple stage evaporators the nal vacuum in the system is about 26 in. Hg and about ne third of the evaporation takes place at a vacuum of etter than 20 in. Hg. Modern plants as a rule use jet ondensers which act as scrubbers for noncondensed ases and entrain the condensed vapors. It is assumed hat laboratory evaporation of weak black liquor at 25 n. Hg throughout is at least as severe a condition for ausing air-borne malodors, and that a surface con-enser at 28°C. is at best no more efficient than a jet con-enser for the condensation of vapors and removal of ases. It is further assumed that the evaporators in lant practice concentrate black liquor from 16% solids o 48% (*13*) and that the amount of black liquor to evap-rator averages 20,000 lb. per ton pulp (*13*). The mount of water evaporated thus is 13,300 lb. water per on pulp. By evaporating in the laboratory black quor from 16 to 48% solids at 25 in. Hg, condensing ne vapors in a surface condenser at 28°C., and trap-ing the noncondensed portions, the following amounts f odor liberated were determined:

Condensate: $SV = 0.012 \times 10^6$. Odor content per ton pulp: $72{,}000 \times 10^6$ GSV.

Not condensed, found in traps: $30{,}000 \times 10^6$ GSV per ton pulp.

Total odor content released in evaporators: $102{,}000 \times 10^6$ GSV per ton pulp (maximum).

Depending on the completeness of condensation by the jet condenser, the actual vacuum employed, and the degree of scrubbing action exerted, it can be estimated that the amount of malodor becoming air-borne may vary from: $10{,}000$–$30{,}000 \times 10^6$ GSV per ton pulp.

Cascade Evaporator to Stack. The conditions prevailing in the cascade evaporation were simulated by passing a gas mixture consisting of 20% CO_2 and 80% nitrogen at 300°F. through strong black liquor (48% solids) until the solids content is raised to 64% solids. It is therefore assumed that the amount of water to be removed in the cascade evaporator is 1700 lb. per ton pulp. It is further assumed, in accordance with the literature, that correct furnace operation leaves no organic sulphur compounds in the flue gases, all being oxidized to SO_2. The only organic sulphur-type malodors contained in the stack gases should be released at the cascade evaporators. It may be stated that the malodors going to the stack are those becoming air-borne in the cascade evaporators.

Heavy pine black liquor from a southern mill (48% solids) is swept by a current of nitrogen containing 20% CO_2 until the decrease in weight corresponds to 1700 lb. per ton pulp. The distillate and sweep gases are suitably trapped and scrubbed (last trap odorless) and evaluated odorimetrically. Odor content trapped per gram of weight loss: $SV = 0.05 \times 10^6$. Total odor content released in cascades to stack: $38{,}000 \times 10^6$ GSV per ton pulp.

Where electrical precipitators are installed between cascades and stack, a considerable but unknown amount of malodors is retained.

It may be noted that evaporating black liquor with hot flue gases containing CO_2 liberates about twice as much malodor per pound of water removed as does concentration by distillation.

Summarizing, the total amount of odor liberated and the amount actually air-borne in the main kraft mill operations are listed in Table III. This table includes the noncondensed digester relief gases, calculated from literature data.

Calculation of Malodor from Literature Data on Volatile Sulphur Compounds

The literature reports a number of studies of the amounts of the chief volatile organic sulphur compounds encountered in pulping which are the source of kraft mill malodor. It is generally agreed that hydrogen sulphide, methyl mercaptan, and dimethyl sulphide are the main cause of the characteristic kraft mill malodor and that minor compounds such as ethyl mercaptan, dimethyl sulphide, and higher mercaptans occasionally reported (*5*), (*14*) are either analyzed with the first three or do not contribute markedly to odor. The results reported by different investigators vary considerably and this is probably due less to analytical difficulties than to different pulping conditions. The publications of Klason (*15*) and Bergstrom and Trobeck (*4*) on the distribution of the three main volatile sulphur compounds form the basis for the calculations of malodors summarized below.

Noncondensed Digester relief gases. Klason's data indicate 10 grams methyl mercaptan and 140 grams dimethyl sulphide per ton pulp. Bergstrom finds 83 grams methyl mercaptan and 39 grams dimethyl sulphide per ton pulp, present in a concentration of 8% by weight in the noncondensed gases. From the SV in

Table III. Amount of Odors from Kraft Mill Operations Estimated from Laboratory Data

Location	Odor as GSV per ton pulp: Total liberated	Odor as GSV per ton pulp: Air-borne portion
Digester, relief	$20{,}000 \times 10^6$	$20{,}000 \times 10^6$
Digester, blow-down	min. $27{,}000 \times 10^6$	min. $27{,}000 \times 10^6$
Multiple effect evaporators	$102{,}000 \times 10^6$	$10\text{–}30{,}000 \times 10^6$
Cascade evaporators	$38{,}000 \times 10^6$	max. $38{,}000 \times 10^6$
	$187{,}000 \times 10^6$	ab. $50\text{–}100{,}000 \times 10^6$

Table II, the total odor content of these gases may be calculated as $16{,}000 \times 10^6$ *GSV* per ton pulp (Klason), $20{,}000 \times 10^6$ *GSV* per ton pulp (Bergstrom). From a paper by Kress (*16*) it can be estimated that with a large laboratory autoclave the amount of noncondensed volatile sulphur compounds is 30 grams sulphur per ton pulp, which is equivalent to an odor content of some $10{,}000 \times 10^6$ *GSV* per ton pulp.

Digester Blowdown. Bergstrom finds that 169 grams H_2S, 516 grams methyl mercaptan, and 4 grams dimethyl sulphide are liberated per ton of pulp which calculates to $145{,}000 \times 10^6$ *GSV* per ton pulp. This is five times our minimum estimate. Under the plant conditions described by Bergstrom the greater part is condensed and the air-borne amount is $58{,}000 \times 10^6$ *GSV* per ton pulp. The pH of the black liquor in question is not stated.

Evaporators. Bergstrom finds 570 grams H_2S and 30 grams methyl mercaptan per ton pulp in the noncondensed gases. However, a dry vacuum pump was used and it appears that with a jet pump most of the H_2S would be dissolved and not become air-borne. Total: $148{,}000 \times 10^6$ *GSV* per ton pulp.

Stack Gases. Klason's data are 250 grams methyl mercaptan and 100 grams H_2S per ton pulp. This calculates to a *GSV* of $70{,}000 \times 10^6$ per ton pulp. This figure may not be pertinent and the malodor may be due to incomplete combustion more than to pickup in cascade evaporators. Bergstrom's figures do not apply since he is analyzing destructively distilled furnace gases prior to combustion.

In sum, the estimation of malodors based on published analyses of odorous sulphur compounds gives results two to three times greater than our laboratory findings. In the field of odor evaluation this may be regarded as fairly good agreement by two independent methods, especially since variables such as the pH of the black liquor exert a major influence on the liberation of malodors (*2*).

ODOR MASKING

Much practical work on masking of one odor with another has been done in recent years, especially in industrial applications, but little has been published on the underlying principles involved.

Earlier claims made by Zwaardemaker (*12*) and others of complete odor compensation and cancellation between odors have been disputed but most authors agree on partial elimination of competing odors by each other and powerful modification of odor impression with mixed odors. Interpretation of odor impressions is a complex field of a psycho-physiological nature. For instance, it has been found that impressions as to pleasantness of odors vary somewhat with the sex of the subjects, with their age, with the time of day, testing before or after a meal. Rather unexpected results have been found, thus the mothball-sweet chemical odor of paradichlorobenzene was judged pleasant by more people than the natural rose note of geraniol (*18*).

Work is under way on the quantitative relationships in odor masking, a subject which does not seem to be dealt with in the literature. We have determined the point where the minimum amount of one odorant modifies faintly but distinctly the odor of another, by way of blending together two dilute aqueous solutions of known odor content, as measured by *SV*. The odor stimulus recognized as producing a *faint but distinct modification* is called a *mask unit* (*MU*). It is expressed as the concentration of the odorant at which it causes the modification, preferably as parts per part of water for aqueous solutions. Contrary to the scent unit (*U*), this value will not be a constant for any one odorant but will be determined by the odor type and odor content of the odorous product being masked. For one pair of odorous substances it will also depend on the odor intensity level at which the masking is carried out due to the operation of the Fechner-Weber Law. In analogy to the scent value, the reciprocal of the mask unit is the number which indicates how many mask units are contained in a masking odorant and we call this number the *mask value* (*MV*). It is a convenient expression of the relative masking ability of an odorant in a given masking problem. Compared to the scent value, the mask value is always the smaller number, inasmuch as in our experience the concentration required to produce a noticeable odor in pure water is always less than the concentration required to modify noticeably any existing odor.

A further useful tool is the concept of *masking ratio* (*MR*) of an odor masking agent. For one pair of odorous substances it is the ratio of the amount of odor being masked (in scent units) to the amount of masking odor (in scent units) which corresponds to an odor modification of 1 mask unit. For instance, masking agent A with respect to isoborneol has a *MR* of 80. This means that this masking agent A is a powerful masking agent for isoborneol, inasmuch as it will noticeably modify an 80-fold amount of isoborneol odor. In turn, the *MR* of isoborneol when serving as a masking agent for masking agent A is only 5, which means that isoborneol is a weak masking agent for masking agent A inasmuch as it modifies noticeably only a 5-fold amount of masking agent A odor. This illustrates that not all masking agents possessing equal odor content will exert an equal masking effect.

For masking agent A as a masking agent for pine black liquor, the *MR* is 70. This means that after diluting black liquor having an odor content of $0.02 \times 10^6 = 20{,}000$ *SV* to say 700 *SV* (28-fold dilution) the addition of 10 *SV* masking agent A will produce an odor modification of 1 *MU*. Since masking agent A contains 33×10^6 *SV* it may be diluted 3.3 million times to produce the effect of 1 *MU* when mixed with an equal volume of black liquor diluted 28 times.

MASKING AIR-BORNE KRAFT MILL MALODORS

It may be assumed that the air-borne kraft mill odors are similar to the odor of black liquor, both possessing

Table IV. Masking Kraft Mill Odors with Masking Agent A Type

Source of malodor	*Distribution of air-borne malodors, % of total*	*Degree of masking*
Digester relief gases	15–25	Some
Digester blowdown	min. 25	Good
Multiple stage evaporators	max. 30	Fair
Cascade evaporators—stack	max. 30	Fair

Total malodor liberated: 187,000 × 10^6 *GSV* per ton pulp.
Air-borne malodors: 50–100,000 × 10^6 *GSV* per ton pulp.
Masking agent A introduced at 20 p.p.m.: 6000 × 10 *GSV* per ton pulp.

he sickening sewer sweetness of dilute mercaptans, odified somewhat by natural odorous wood constitents such as turpentine, pine oil, anethole, borneol. ssuming therefore that the masking ratio of masking ent A for air-borne malodors is 70, it is possible to imate the amount of masking agent needed for achiev- a masking effect of 1 *MU*.

Assuming, in line with our findings, that the air-borne alodors under favorable circumstances amount to 0,000 × 10^6 *GSV* per ton pulp, the masking to 1 *MU* ill require (50,000 × 10^6)/70 = 700 × 10^6 *GSV* per on pulp. One gram of masking agent A contains 33 × 0^6 *GSV* so that the amount of masking agent A needed (700 × 10^6)/(33 × 10^6) = 21 grams per ton pulp, omewhat less than 1 oz. The amount of masking gent A used in plant operations commonly has been 0 to 20 p.p.m. based on the digester content; based on ulp the concentration therefore has been 100 to 200 .p.m., equal to 90 to 180 grams per ton pulp containing 000–6000 × 10^6 *GSV*.

If all the masking agent A became air-borne there ould thus be present four to eight times the minimum mount of masking agent needed to produce an odor odification. It is known, however, that actually a art of the masking agent goes into the liquid condenates where it exerts some masking effect.

From the volatility of masking agent A with steam it ay be calculated that 70% vaporizes with the digester lowdown and small amounts with the noncondensed ases. The remaining 30% is almost completely vaorized at the evaporators and cascades.

On the basis of laboratory studies on black liquor and xtrapolation to mill conditions, the over-all picture of he degree of masking achieved with masking agent A nd similar types in the paper mill may be summared in Table IV.

MILL TRIALS

The odorimetric studies described earlier offered a ss empirical and more definite approach to the delopment and mill scale evaluation of suitable masking gents. It was, therefore, important to establish a int laboratory and mill program.

In the latter part of 1951 such a program was started intly by the Du Pont Co. and the Gulf States Paper orp., Tuscaloosa, Ala., to explore the use of odorous emicals in masking kraft malodors.

This interest in abating malodors in kraft mill operaons was in keeping with efforts toward control of poltion in both air and stream. Considerable progress d been accomplished in minimizing malodors in ream pollution. However, available methods for mination of malodors from the atmosphere involving eir collection had not been completely successful, and generally capital expenditures of large proportions were required.

Awareness of the acute situation requiring definite steps toward an abatement of kraft malodors prompted the farsighted management at the above mill to extend their full cooperation and plant facilities in the mill trials we are about to describe.

Atomizing of Masking Agent. The masking agents initially available were deficient in stability under digester cooking conditions. In the first mill trials the masking agents were atomized into the contaminated atmosphere. The first trial was run during a 15-day period with selected masking agents, atomizing these oils or their aqueous dispersions directly into the air-gas stream entering the mill furnace stacks. The application was made on the induction side of the exhaust fans. The rate of exhaust on each of two stacks was 400,000 c.f.m. The mill equipment for applying the masking compound was specially designed and consisted of a $^1/_2$-in. pipe halfway inside a 1-in. pipe and welding the 1-in. pipe into an opening in the stack. Compressed air was connected to the inside pipe and a small hole drilled in the outside pipe to introduce the masking agent. The suction created by the compressed air pulled the odorant into the air-gas stream and atomized it. The rate of flow was controlled by a valve adjusted to the air pressure of 30 to 40 p.s.i. pressure. A gravity feed system was used for the masking agent. Concentrations used were regulated to give 1 to 100 p.p.m. of the compound in the air-gas stream. The results of this early test were not encouraging.

There was no marked change in the malodors from the mill as they were observed at distant points down wind. The masking agents themselves at the higher concentration were detectable, but only within a few hundred yards of the operation depending on the wind and weather. At the higher concentrations the cost would have prohibited the treatment even if it were shown that masking agents of the type selected could and would disperse in air over a large terrain.

These first tests, therefore, were helpful in disclosing the need for specially designed products capable of being introduced directly at some earlier point or points into the sulphate process itself and of being volatilized during the process simultaneously with the malodors. During this period of exploration of the kraft mill odor problem and the attempt to spray or atomize masking agents, various samples of black liquor, etc., were forwarded to the research laboratory. From an odorimetric study of these samples, and of the conditions during the pulping process, a number of masking agents were developed with special attention to chemical stability and masking intensity. It was believed that in practical field work they would prove to be satisfactory masking agents. One type is designated here as masking agent A.

Masking at the Multiple Effect Evaporators. It has been indicated that laboratory studies gave indication that considerable malodor may be liberated from the black liquor at the multiple effect evaporators. If the efficiency of the evaporator system is impaired, or the completeness of the condensation by the jet condenser is unsatisfactory, and the degree of scrubbing action exerted faulty, then considerable malodor may become air-borne.

Practical tests were run in this part of the sulphate process to determine the coverage of malodors originating at this point, to further check, if possible, whether malodors survived the reduction furnace, or were, prior to reduction, carried out of the furnace stacks. Masking agent A types were added directly to this system daily for a period of 1 month. The concentration used varied from 1 to 6 p.p.m. based on total daily volume of black liquor through this system. Injection of the masking agent occurred at the early stage of evaporation by mechanically pumping it into the black liquor as it entered the system.

Observations during this period of tests indicated that with proper evaporators the actual malodors released were not very intense and that the masking agent used did withstand the high evaporator temperatures and were evident in the black liquor during all of the evaporation stage. There were also indications that little of the malodor was released at the fume stacks. We became convinced that the multiple evaporators and the recovery system need not be the main contributors of malodors released to the atmosphere. This appeared to be true regardless of a generally-held belief to the contrary. The actual odor from the recovery system at the stacks is a typical combustion odor which we would describe as "burnt" and which is hardly objectionable. This was observed not only during the 30-day test, but from later observations during trials at several different plants. As a further check gas samples and condensates taken from within the stack were examined with no evidence of large concentrations of malodors. We believe it often unnecessary, based on these trials, to make additional application of masking agent at the stack or evaporators, provided the masking agent has been applied at the digester whence a portion is carried to the evaporators and the stack. This is also true when such gases are scrubbed in a tower with concentrated black liquor such as may be employed when operating a "Goodall" type recovery.

Masking at the Digester System. Although it was recognized that the malodors originating from the recovery system contribute substantially to the total malodor, we were now satisfied that these malodors originate earlier in the process. We therefore began the study of malodors from the digesters. Obviously, here was the source of all of the malodors, for here they are created. The masking agents for test had been designed to be resistant to the digester conditions and the first experimental trials were carried out on a semiplant scale with a 30-gal. digester in order to confirm this point. The selected masking agent was added to this digester after loading it. The concentrations employed during these tests ranged from 1 to 50 p.p.m. It was established that the most satisfactory odor control was between 10 and 30 p.p.m. At lower concentrations the masking action was weak, while at higher concentrations there was an obvious odor of the masking agent which we desired to avoid. Equipped with these data, and the odor-measurement yardstick described earlier in this report, practical trials were run over many months, in various mills, under various local weather conditions.

Procedure. The selected masking agent was added directly to the digester, manually, after the usual procedure of closing the blow valve and filling with chips and liquor. Concentrations were adjusted to parts per million based on the total weight charge of the digesters (wood, moisture, liquors, and steam, in the case of direct heating). These are some of the results:

Soon after beginning of the treatment the masking effect was readily noticed at the following accessible points:

Relief gas condensate (turpentine)
Blowdown steam on roof
Blowdown condensate when condensers were in operation
Weak black liquor
Rotary washers
Condensate from multiple effect evaporators
Heavy black liquor after evaporators
Area within mill
Downwind outside mill for several miles

The extent of the masking effect at these mill observation points varies with mill digester and recovery systems and is influenced in part by type of wood, sulphidity, relief system, terrain, and general weather conditions.

To judge the effectiveness of masking malodors, especially those from the digester system, we set up observation points on a $^1/_4$ to 1-mile radius downwind from operations, and also at 2 and 5-mile points. Observations were made of each blowdown recognized by its plume of steam. Tests were run during periods of weeks and comparisons were made between periods with and without masking agent and at various levels of concentration of the latter. It was observed conclusively that the majority of typical malodors considered objectionable did come from the digester system. The malodors were intermittent at the $^1/_4$ to 1 mile radius, but as the odors became dispersed in the air and were carried downwind 2 to 5 miles, they became continuous. At the $^1/_4$-mile observation point, depending on wind velocity, the malodor took less than a minute following the start of blowing of the digester to become perceptible. Considerably less objectionable odor was noted during the intervals between digester blowdown. This was especially true of the stack odors in well-regulated operations. When stack gases were driven down to the ground they could sometimes be smelled separately and the resemblance of their odor to that of coal burning equipment was pronounced. During the observation tests the weather varied from fair to gusty and cloudy followed by heavy rains, later with ground fog, and finally with considerable ground air turbulence. During fair weather the odors were particularly intense in the early mornings and late evenings. During the period of unsettled weather they were more intense and continuously detectable, particularly in the 1 to 2 mile radius. Ground air turbulence seemed to produce an uneven scattering of the malodors so as to form pockets, some of which could be observed well beyond the five-mile observation point.

Masking at Other Malodorous Points. During the extended trials it was generally found that addition of masking agent at the digesters, with partial carry-over into the recovery system gives sufficient all-around protection. Only occasionally has it been necessary to supplement the treatment at other points of the operation. When such conditions do exist, they are readily recognized. A few such odorous conditions which have been noted are as follows:

. Malodor from lime kiln operations. This is usually drogen sulphide.
2. Those points where waste condensate from blowdown con- sers are used for washing.
. Fumes which are drawn from the multiple evaporators ctly to stacks rather than to sewage.
4. Noncondensed gases at turpentine recovery which may not scrubbed and are released directly to the atmosphere rather n to sewage. These noncondensed gases are more pro- nced in malodor in some operations than in others.

Soon after beginning the addition of masking agent at digester system a marked improvement in the odor the surrounding area is generally reported, not only mill officials, but by interested groups not associated h the kraft industry. This odor abatement is, in mmon with all descriptions of odors, a difficult sub- t to define in words. However, it can be described a change and modification in the kraft paper mill r. The repulsive odor of the sulphur compounds is longer prominent. It seems partly suppressed and tly modified to a more pleasant note. It has been scribed by some as woody, or soapy. Others feel the w odor represents largely a reduction in intensity of malodors themselves.

Panel surveys were established during trials and some the opinions as expressed by such groups, represent- management, mill personnel, community groups, well as those associated with the technical aspects, e here recorded:

Mill A: "I noticed a difference in the air in the mill nd I can't smell the black liquor odor even in the pulp self, prior to bleaching. . ."

"We notice that our clothing doesn't smell as badly as efore. . . ."

"It smells better, we hope they will continue using ."

From an infrequent visitor to the mill area: "A defi- ite change–last year when I drove through, the odor as horrible; today there is practically no odor at all."

Mill B: "There is a definite improvement in the at- osphere, even 10 miles away. . . ."

"Impression we had was not that of a paper mill at l, but rather that of any operation involving com- ustion. . . ."

"A change, but I can't say I like it—I've been in a aper mill all my life and I'm used to the odor; how- ver, the Mrs. says, it's good. My clothing, shoes, and air don't smell badly."

Mill C: "It appears that within the immediate mill ea and in the mill a very definite abatement of the ormal kraft odors has been accomplished. . . ."

"On a clear windy day when the gases and fumes are read over a wide area, the normal kraft odors are asked throughout the surrounding territory. . . ."

"On heavy, mucky, windless days, the fumes and ses are concentrated in a small area and the normal raft odor is evident. . . ."

"It could be better. . . ."

"Our group feels you have masked about 75% of the lor. . . ."

Blank "expressed complete satisfaction, a decided provement in their valley town."

These observations by those close to kraft mill opera- ons are not quantitative, they are not scientific, and ey are not even uniform. But they express fairly a general trend of reaction to a matter that cannot be measured by any exact yardstick.

COST OF APPLYING MASKING AGENT

When measured against the cost of alternative methods of odor abatement, the cost of masking at the digester system is small. This is especially so with respect to capital expenditures and labor and maintenance. With manual addition there are no capital expenditures and the operating labor is negligible. Yet it seems highly preferable to provide, by means of small proportioning pumps, for the mechanical addition into the stream of white or black liquor entering the digesters. This assures uniform addition, free from human error, and eliminates occasional complaints when the nontoxic, but intensely odorous masking agent drips on hands or clothing. In this pioneering work, the cost of the masking agent itself was from about $0.12 to $0.24 per ton of pulp at the usual concentrations. For even better abatement or for some hardwood operations the cost was somewhat higher. Improved masking agent types and improved techniques, when developed, may reduce this cost.

In conclusion, we are aware that the kraft mill odor abatement described by us is in need of further study and further improvement. The observations in the field on a plant scale have not completely borne out the laboratory findings or theories, and similarly the data found in the literature are neither uniform nor self-consistent. There are many unanswered questions because of the imponderables introduced by the variations in the kraft process on the one hand, and the difficulties involved in the measurement and description of odors on the other hand. It is our hope that with continued study and a better understanding of both sets of factors, it may be possible to develop more highly efficient masking agents. Then this method, which is extraordinarily simple in its application, will render more assistance in the abatement of paper mill odors and thus will contribute to the continued rapid expansion of the alkaline pulping industry.

LITERATURE CITED

1. Hagglund, E., *Pulp Paper Mag. Canada* 24: 1381 (1926).
2. Dexter, G. M., *Paper Trade J.* 129, No. 21: 78–81 (1949).
3. Hisey, W. O., *Tappi* 34, No. 1: 1–6 (1951).
4. Bergstrom, H., and Trobeck, K. G., *Svensk Papperstidn.* 18, No. 3: 49 (1945).
5. Dalla Valle, J. M., and Dudley, H. C., *U. S. Public Health Reports* 54, Pt. 1: 35 (1939).
6. Barail, L. C., *Soap & Sanitary Chem.* No. 6: 133 (1949).
7. Standard Methods for the Examination of Water and Sewage, American Public Health Association, New York, 9th ed., 16–20 (1946).
8. Fair, G. M., and Wells, W. F., *J. Am. Water Works Assoc.* 26: 1670–1683 (1934).
9. Spaulding, C. H., *J. Am. Water Works Assoc.* 34: 877 (1942).
10. Helbig, W. A., *J. Am. Water Works Assoc.* 31: 1931 (1939).
11. Abderhalden, E., Handbuch der biologischen Arbeitsmethoden, Abt. 6, Pt. A, 775 (1927).
12. Stephenson, N., "Pulp & Paper Manufacture," vol. 1, page 483, McGraw-Hill, 1950.
13. Stephenson, N., "Pulp & Paper Manufacture," vol. 1, page 538, McGraw-Hill, 1950, and private communications.
14. B. C. Research Council, *Paper Trade J.* 134: 14 (1952).
15. Klason, P., *Paper Trade J.* 30 (July, 1924).
16. Kress, O., and McIntyre, J. W., *Paper Trade J.* 100, No. 8: 43–46 (1935).
17. Abderhalden, E., Handbuch der biologischen Arbeitsmethoden, Abt. 5, Pt. 7, 514 (1930).
18. Kniepp, E. H., *et al.*, *Am. J. Psych.* 43: 406 (1931).

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Spent Sulphite Liquor Studies

IV. Use of Spent Liquor in Reconditioning Asphalt Road Surfaces

A. J. WILEY, WALTER SHERMAN, GEORGE BABLICK, NEAL RICE, G. K. DICKERMAN, and GROFF COLLETT

Reformation of worn asphalt or "blacktop" road surfaces has been found to be promoted by inexpensive applications of spent sulphite liquor during regrading operations. Practical road tests in Wisconsin have shown that secondary roads in advanced stages of raveling can be reworked with a grader to pulverize and redistribute the old surface material, after which spent sulphite liquor applications from tank trucks serve to accelerate the formation of a new and tight, bituminous-type surface within a few days under normal traffic. Such reformed surfaces, without use of new asphalt binding material, have been observed to stand up well after a year of service through a Northern Wisconsin Winter and without apparent damage from Spring breakup. Methods used in the road trials to date are described. Laboratory trials are being carried out to confirm the reformation characteristics of sulphite liquor application to test material taken from old roads. Deformation and shear tests are in progress. Preliminary strength tests (Marshall stability) which have so far been completed tend to confirm the experience of the road trials in terms of good load-bearing capacity. Some observers are of the opinion a transitional and preliminary softening reaction of the broken asphalt aggregate occurs after application of spent sulphite liquor. Such a reaction might contribute in part to the reformation characteristics, but laboratory evaluation of this phenomenon has been difficult to carry out and to confirm.

THE subject of this paper is an unexpected and interesting development arising from the use of spent sulphite liquor as a dustlayer and roadbinder on dirt and gravel roads. Application of the liquor to the reconstruction of worn-out asphalt (bituminous) road surfaces offers promise for a new type of resurfacing treatment, permitting reuse of the original asphaltic cement binder and of the expensive aggregates present in the old surface. Much remains to be learned about proper methods for using the liquor in asphalt road reconstruction and the long term life and wearing qualities cannot yet be known. However, test road and laboratory experience over the past 2 years is such that practical road authorities foresee possibilities for this method as a new means for low-cost reconstruction and maintenance of light bituminous road surfaces. These observations seem particularly applicable to secondary roads under medium to heavy service for which maintenance financing is becoming increasingly burdensome to local taxpayers.

For many years this spent liquor by-product of sulphite pulp mills has been known to be of value as a temporary dustlayer medium. In more recent years knowledge and recognition of the strong binder properties of the liquor and concurrent development of proper methods of application have led to its increasing employment as a binder for road aggregates. In such use as a binder the lignin content of the liquor apparently acts as a base stabilizing agent for soil and gravel subsurfaces and also as a surfacing agent capable of forming extremely hard, smooth-wearing surfaces. The weathering properties of properly laid roads of this type can be surprising in view of the water-soluble nature of this binder. These known outlets for spent sulphite liquor are practiced extensively within reasonable truck hauling distance of sulphite pulp mills throughout the northern tier of states in this country and also in pulp-producing areas of Canada, Germany, Sweden, and Finland. Approximately 30,000,000 gal. of blow pit strength spent liquor were used for roadbinder and dustlayer on 2500 miles of secondary roads in the Wisconsin area during 1952.

Interesting properties of spent liquor when applied to asphalt bound road aggregates were first noted by two of the authors [2, 3] in the Summer of 1951. Confirming road trials were conducted in the Summer of 1952, and comprehensive laboratory studies have since been initiated. Observations, methods, and results of tests are summarized in this paper for use of others who may be interested in trial applications elsewhere. The authors wish to emphasize need for further evaluation of methods of application before full use of the principles can be made in routine road work.

DESCRIPTION OF ROAD TESTS

Road reconstruction tests so far made in Wisconsin have been applied to secondary type roads with light to medium traffic conditions and for which the old asphalt road surfaces range between 2 and 3 in. of average thickness. Available road construction histories indicate that the asphalt binders originally used on these test sections were of the medium viscosity, slow or medium curing (SC-3, MC-3) types of asphalt road oil. These grades are more or less standard for secondary bituminous surfaced roads and streets in the Wisconsin area.

The original sections of treated road covered $3^1/_2$ miles of two township roads running west from the junction with State Highway 13 in the Town of Chip-

(1) A. J. WILEY, Technical Director, Sulphite Pulp Manufacturers' Research League, Appleton, Wis.; (2) WALTER SHERMAN, Assistant Manager, Flambeau Paper Div., Kansas City Star Co., Park Falls, Wis.; (3) GEORGE BABLICK, Town Chairman, Ashland County, Wis.; (4) NEAL RICE, Research Chemist, Natural Resources Research Institute, University of Wyoming, Laramie, Wyo.; (5) G. K. DICKERMAN, Technical Director, Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.; (6) GROFF COLLETT, Business Manager, Sulphite Pulp Manufacturers' Research League, Appleton, Wis.

a near Butternut, Ashland County, Wis. These road sections had received an SC type blacktop atment 2 years previously, but some areas were aking up badly from traffic by logging trucks in 1951. was not at that time possible to carry out a complete rfacing job with new asphalt binder so the road sur- was regraded as for a gravel road. The old surface

. 1. Typical broken surface of worn blacktop road before treatment

s scarified and reworked. In order to help consoli- te the coarsely broken material, the grader then rked in about 300 cu. yd. of pit run gravel (a mixture crushed rock, sand, and clay) for each mile of 16-ft. ad. Blow pit strength spent sulphite liquor was oded on and road mixed at a rate of approximately gal. per sq. yd. to bind the new and old aggregate ac- rding to the accepted practice for binding and dust- ing on gravel roads in that pulp mill area.

The grading equipment operators observed that the ge chunks of old asphalt surface material seemed to lverize with much greater ease after adding the spent phite liquor than is usually the case. At first, the ad appeared much like other newly graveled roads in e area, but inspection over a period of time disclosed at these repaired sections of road soon consolidated o a hard surface under normal traffic and then had ach the appearance of the original, black-colored, ht-surfaced, asphalt-bound road. This occurred in te of the new aggregate which had been added. The iformly dark to black-colored appearance of the ooth hard surface seemed to indicate that the old halt had in some way been redistributed and worked the surface during consolidation by traffic. The new face stood up very well through the Winter of 1951–

These results were brought to the attention of local d authorities and were of such interest as to merit re complete evaluation. The original test sections Ashland County which remain under observation in ir second year have since been supplemented by d trials in Morrison Township of Brown County, theast of Green Bay, Wis.

It is somewhat difficult to obtain closely controlled experimental conditions on public roads subject to uninterrupted traffic, but insofar as possible to do so arrangements were made to divide these test roads under reconstruction into treated sections with adjacent untreated controls. Broken areas totaling about 1 mile in length on a town road running through the Village of Wayside and $^1/_5$ mile east of Brown County Trunk G were scarified and graded, after which spent liquor was applied to the chosen test section at rates equivalent to about 0.7 gal. per sq. yd. on the edges and 1.4 gal. per sq. yd. in the center traffic lane. Unfortunately, the control sections immediately adjacent to the test section were also treated with liquor by the road crew. However, another and similar section of road prepared at the same time about 1 mile away was left entirely without spent liquor application and this subsequently served as a control.

Observation at 24 and 48 hr. served to show the usual dustlaying quality of the liquor on treated areas. This contrasted markedly with the dusty conditions where no liquor was applied. However, the road surface remained extremely rough from unbroken large lumps of broken asphalt bound aggregate on treated and untreated sections with little evidence of consolidation in the first 48 hr. During succeeding days the traffic lanes gradually reformed into a firm surface on the treated areas.

At seven days the treated road section was in an advanced stage of reconsolidation. Pictures taken at that time are used to illustrate the following description:

Figure 1: This shows a typical stretch of broken blacktop road surface which extended some 500 yd. beyond the treated length of road to be shown for comparison in succeeding photographs. It will be noted that the worn surface had raveled badly in the principal traffic lanes and that much of the surface remaining was traversed with long cracks and pitted with holes.

Fig. 2. Reformed blacktop road surface after treatment with sulphite liquor

Figure 2: In this figure a length of treated road adjacent to the untreated section illustrates the typical smooth dark appearance of a reconstructed road in a well-advanced stage of reformation. The surface of this section had been scarified and broken up, treated with spent liquor, and regraded. Seven days of

normal traffic on this country road have consolidated the surface to a dense, hard finish.

Figure 3: The same length of treated road, photographed facing the sun, demonstrates the hard, somewhat shiny surface which developed in the main traffic lanes after reformation of the new surface. Some loose material along the edges of the road had not been consolidated at the time of taking the photograph.

Figure 4: A close, oblique view down on the treated road surface shows the dense, hard, and smooth surface after consolidation. This also shows a softened lump of the broken aggregate found along the edges of the road. Such softening of these lumps appeared to be a transitory characteristic of the broken asphalt wherever treated with spent liquor. Light pressure of the foot or between the hands served to crush and pulverize these broken pieces of asphalt bound aggregate.

Figure 5: This photograph looks down on the loose, dusty surface of the nearby control section of road and illustrates the sharp contrast to the previous photograph of treated road surface. The surface of this control section was broken up and regraded but was not treated with spent liquor. There was no reformation of a new surface and the large lumps of broken aggregate found along the edges of this road were quite hard and could only be broken by hammer blows. Figures 4 and 5 were both photographed in mid-afternoon of the same day, and it would be difficult to account for the softening of liquor-treated aggregate on the basis of temperature difference.

Figure 6: Dust raised by a passing car is shown in the view down the stretch of untreated control road. This section of road near the junction with a main county highway within the limits of a small farm community probably had heavier traffic than the treated road sections, yet there was little evidence of consolidation by traffic at the time of photographing (7 days) nor in subsequent observations up to the time when an entirely new blacktop surface was applied to this control section some four weeks later. Much loose material remained on the rough surface throughout the period of observation.

The most recent inspection of these test road sections on town roads in Brown County has shown a principal

Fig. 3. Characteristic sheen of treated and reformed blacktop road surface

treated section to be in generally good condition in mid-Winter after 6 months of service. The surface is not as smooth as earlier in the experiment in that some of the fines surrounding individual firmly embedded pieces of gravel aggregate had eroded away to a limited extent. This "gravel roughness" still presents a smooth hard travel finish for traffic free from ruts or washboard. A few small holes in the surface indicate spots where broken lumps of aggregate had not been completely pulverized.

Another section of the resurfaced test road had broken up badly in the 6-month period. This section appeared to have an insufficiently stabilized base and surface treatment could not stand up under traffic.

Fig. 4. Close view of hard treated surface and of softened lump of aggregate

The local road supervisor has been well impressed by the test roads prepared under his supervision, and has indicated that plans call for doing more surface reconstruction work with spent liquor treatment on his secondary bituminous surfaced roads in the coming road season.

Several other highway units in the Wisconsin area have prepared trial sections of worn bituminous road for evaluating the surface reformation characteristics of spent sulphite liquor. The City of Green Bay has treated some six blocks of MC-3 asphalt surfaced streets with spent liquor. The reformation of a new tight surface, was found to take place in a short period under normal traffic. The city street superintendent, in common with others reworking the old asphalt surface, has observed a softening effect on broken, scarified road material after treatment with spent liquor. Mechanical pulverizers could not break the lumps prior to such treatment but were easily able to do so after treatment.

Other test sections of road surface reformation are understood to have been tried at Park Falls, Wis., and by the Brown County highway department. A comprehensive review of these test sections is anticipated prior to setting up more closely controlled tests during the 1953 highway construction season.

LABORATORY TESTS

The interesting potential for a new and inexpensive method of reforming a new surface with use of the old surface material has been such as to necessitate laboratory evaluation of the wearing and load characteristics of the reformed surface. It is also recognized that these preliminary tests probably have not developed optimum

thods for use of the spent liquor on road resurfacing. The Sulphite Pulp Manufacturers' Research League established a development and test program for such luation by its own staff and also in the laboratories the Natural Resources Research Institute at the versity of Wyoming. Results of this research pro- m are still in preliminary stages of evaluation, but

. 5. Close view of broken and scarified control section th hard lumps without treatment with sulphite liquor

e following tentative conclusions are expected to be use in planning future road-scale tests.

1. Spent liquor requirements for effective surface formation apparently lie in the range of $^1/_4$ to 1% by eight of spent liquor solids as based on the weight of ad aggregate under treatment. The amount of solids quired for optimum strength probably varies with the aracter of the original aggregate, but that range of quor solids usage would involve use of from 9500 to ,000 gal. of 10% solids liquor per mile of 18-ft. road rface treated to an average depth of 3 in. when the gregate had a finished density of 140 lb. per cu. ft. his compares with an apparent usage of from 7000 to ,000 gal. per mile of road in the Brown County test ove described.

2. Exact comparison of Marshall stability tests for ading strength of the reformed surface material has en handicapped since the reformed surface material s modified characteristics which differ from that of shly prepared cylinders of hot laid asphalt for which e Marshall test was devised. However, confined com- essive strengths of cylinders of reformed asphalt road gregate treated with spent liquor have indicated that ads to failure range upward of 3000 lb. and under timum conditions exceed 4500 lb. These loadings mpare favorably with that for standard asphalt ecifications.

3. Reformed asphalt aggregates treated with spent lphite liquor are characterized by high densities on e order of 135 to 140 lb. per cu. ft. and can be made to ve a comparatively low percentage of voids ranging m 7 to 12%.

4. Marshall test specimens have shown flows of m 0.11 to 0.20 in. in the better test samples, and flow may exceed 0.2 in. when too much moisture is present in the finished test specimen.

5. Moisture levels in the cured samples apparently average about 1.5%. The moisture level can be made to be a function of the spent liquor concentration and of drying conditions of the road surface after treatment with the liquor.

6. Laboratory tests have not confirmed or explained the apparent softening reaction repeatedly observed on spent liquor treated roads.

SUMMARY AND CONCLUSIONS

Test roads have shown that worn bituminous road surfaces can be scarified, treated with spent sulphite liquor, then pulverized and regraded to form strong new surfaces without other use of new and expensive surface materials.

The reformed surface can be prepared to have strength and load-bearing capacities comparable to original bituminous surface. The use of this principle may be especially valuable where frequent repair or reconstruction of road surfaces presents burdensome expense. Reuse of the old surface material presents definite possibilities for large economies. However, it is improbable that such reformed surfaces will stand up better than other types of light surfaces over inadequately stabilized road base.

A second use for the reformed bituminous surface material has been postulated by several road authorities but not yet tried. It seems feasible that the reformed material might be used as a firm stabilized base for new surfaces where experience shows necessity for base stabilization prior to new surfacing of any kind. The high density and low percentage of voids shown by laboratory tests of reformed aggregates seem especially pertinent to road base stabilization.

Fig. 6. Dusty section of untreated control section of road. Aggregate remains loose and rough

These uses for spent sulphite liquor in the road construction field are to be developed further as experience is gained during coming road construction seasons.

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The Manufacture and Properties of Chlorine Dioxide

E. KESTING

Commercial interest in chlorine dioxide has greatly increased since the last war, and it is now particularly the wood pulp industry which is concerned with its manufacture and application. Although it is a chemical of considerable latent energy which is ready to initiate explosive reactions with almost any combustible or oxidizable matter, safe and efficient ways have been found for its manufacture and handling. The problem of transporting it in compressed or liquid state has, however, not yet been solved and it is necessary, therefore, to make it at the place of application. Sodium chlorite is available for this purpose but the rather circuitous steps involved in this procedure lead to high costs and restrict its use severely. Other industrial procedures now carried out at various mills were founded on the use of solid sodium chlorate and its conversion first into chloric acid and the reduction of the latter to chlorine dioxide by various agents. The basic intention in each case is to obtain in one step or in a series of simultaneous steps a maximum yield of chlorine dioxide from the expensive chlorate as the accruing waste products prohibit the re-use of the exhausted liquor. Much stress is also put on making the dioxide as free of chlorine as possible. Due to the ease with which both can be separated, these efforts seem rather pointless. The Kesting process, which has already produced several thousand tons of chlorine dioxide, follows a different pattern. It makes chlorine dioxide from hydrochloric acid, water, and electric current. The carrier for the oxygen needed in the oxidation of the hydrochloric acid is a solution of sodium chlorate which continuously circulates between the dioxide reactor and an electrolytic cell for fortification. No sodium chlorate and no sodium chloride —the initial charge excepted—need to be purchased and there are no waste products. The process is continuous and exceptionally well suited for automatic control. The cost of the chlorine dioxide thus produced closely approaches that of hypochlorite chlorine, both measured on an active basis.

ALL have heard of chlorine dioxide and know that its importance in connection with pulp bleaching is increasing very rapidly. Although the relative discussions and the publicity are of comparatively recent date, chlorine dioxide as a chemical compound is not new. Its discovery dates back to the beginning of the past century, and Davy prepared it by pouring strong hydrochloric or sulphuric acid on chlorate. As has happened so often, he had discovered a basic reaction which is still being followed today in the preparation of chlorine dioxide and is represented by the following equation:

$$NaClO_3 + 2HCl \rightarrow ClO_2 + Cl + NaCl + H_2O$$

Now those who are chemists will remember immediately from their early lessons that this is one of those reactions about which our teacher cautioned us not to be too inquisitive. If, nevertheless, we wish to verify it, we should be very careful, at least if solid chlorate and concentrated acid are used, because the system is dangerous and leads without fail to explosions. However, we must apply just this very reaction from which we should keep away if we wish to manufacture chlorine dioxide, and a little later the author will indicate how this can be done without danger.

Chlorine dioxide is a gas of yellowish or orange color which resembles chlorine in many respects. Its density is almost the same, and the smell is alike, only perhaps a bit more pungent as if there were some ozone admixed. With a little experience, one is able to distinguish the two gases by their smell. The physiological properties are analogous in their effect upon the human breathing mechanism, but chlorine dioxide has the extra effect of causing violent headaches and general fatigue which last for several days. It is therefore necessary to consider these specific poisonous qualities when the industrial use of chlorine dioxide is contemplated.

One important characteristic of this compound is its easy solubility in water and aqueous solutions of various salts. In this respect it surpasses chlorine, and at equal temperatures water may contain five times as much dioxide as chlorine. This different solubility furnishes a practical means of separating these two substances which are otherwise so similar.

The most obvious characteristic of chlorine dioxide is, of course, its explosiveness. Through rather bitter experience, the chemists have discovered that it explodes when its temperature is being raised, or if it is being exposed to light, or allowed to contact organic substances. This inclination to blow up at the slightest excuse is still greater in the liquid state. There it has been observed that the mere transfer from one container into another causes an explosion. Conditions are aggravated by its extreme readiness to detonate. The violence of these blowups is quite in line with that of oxygen-hydrogen mixtures, and the effect of liquid chlorine dioxide explosions is comparable to that of the strongest chlorate explosives.

Knowing all this, there will be apprehensions with regard to the risks entailed in the production and handling of chlorine dioxide to the extent of several tons per day. But it is just this knowledge that makes it possible to achieve our purpose without endangering men or equipment. To start with, elevated temperatures and exposure to light or organic substances must be excluded. This alone, however, does not suffice. Absolute safety in manipulating this compound is reached by making use of the fact that the explosiveness of this gas diminishes greatly when it is mixed with inert gases. If, for instance, air, nitrogen, or carbon dioxide is added as diluting agent, say to the extent of 90% of the mixture, the chlorine dioxide is no longer dangerous and does not react to limited temperature increases. If the chlorine dioxide percentage is still further reduced

E. KESTING, Manager, Elektrochemische Werke, Munchen, West Germany.

losions no longer happen and only gradual decomtion into chlorine and oxygen in an exothermic tion is observed. At still lower partial pressures n this decomposition is arrested.

onsequently by utilizing these findings and paying ntion to the special notions of this compound, it can safely manufactured in diluted gaseous form and losions do not occur. For industrial purposes the ide is mostly applied as aqueous solutions, and these tions are entirely harmless.

ne important characteristic of chlorine dioxide is it does not react chemically with water. For mple, it is possible to expel the dioxide from its eous solution just by blowing air through it. As gas escapes, the original yellow of the solution fades it finally becomes colorless. If this colorless resiis analyzed a very weak acid reaction is found which ates that only negligible amounts of chloric acid e been formed. From these facts, it can be conied that the chlorine dioxide is dissolved in water such, without reacting with it chemically. Also ay be pointed out at the same time, that such soons can be stored in the dark for weeks and months hout losing strength.

hlorine dioxide, as gas and in aqueous solution, is ngly oxidizing and, therefore, extremely corrosive. e choice of materials which may be used in contact h it is very limited. In fact, so far only ceramic ducts such as glass, porcelain, or stoneware have ved entirely resistant. Satisfactory experience has en obtained with polyvinyl chloride, but only in its re form which means that no fillers or plasticizers uld be present. Rubber in any form is unsatistory and that holds also for ebonite. Practically all tals are attacked and only platinum and tantal are ficiently resistant, but their price is so high that ir use in any qualitity is excluded. Iron silica als with high silica content have been found to be use-

Anybody who handles chlorine dioxide or chlorine xide solutions must make sure that no oil, fat, coal, phur, rubber, or similar material is allowed to con- it. The chemical reactivity of chlorine dioxide is y great with all known compounds, and particularly h reducing agents. Therefore, it is easy to reduce with carbon, sulphur, sulphur dioxide, hydrogen roxide, and such metals which are able to form difent levels of oxides, and if they are present in the er potential—for instance, nickel, chromium, manese, lead, and iron. They all reduce chlorine dide either to chlorite or chloride, depending on reion conditions. Carbohydrates such as wood, lulose, and pulp are also reducing agents but of her low reactivity and for this reason chlorine dide may be used in pulp bleaching.

Before considering the manufacturing methods of orine dioxide, the author wishes to make a few reks about sodium chlorite. After the research work E. Schmidt on chlorine dioxide done in the early enties had become known, many industries had bene desirous of using it in their process. However, commercial production with the means available that time was entirely out of the question. This ted until about 15 years ago when the Mathieson emical Corp. proposed to manufacture, as an intermediary, solid sodium chlorite, a chemical compound which had been known for many years. This salt is rather harmless, and it can be conveniently used for making chlorine dioxide simply by treating its aqueous solution with an acid. Therefore, it was possible to furnish it to the prospective consumer who in turn would produce the desired chlorine dioxide in his own plant without danger and would thus have it available for whatever purpose it was wanted.

Although this is not the place to go into the manufacturing details of sodium chlorite, a few explanatory remarks may be in order. The process is not simple. It consists essentially of three steps, namely: the preparation of chlorine dioxide, its reduction to the chlorous acid ion which in turn is chemically combined with sodium hydroxide. Sodium chlorite is a rather harmless salt, and its properties are not unlike those of sodium chlorate so that it may be transported without extra-special precautions in iron drums which have a protective coating on the inside. There is, however, one precaution that must be observed when handling this chemical, and that is to avoid any direct contact with combustible matter such as wood, coal, sulphur, textile, and the like, because these will ignite immediately. It is very easy to liberate the chlorine dioxide from the chlorite solution; simply adding an acid is sufficient. The reaction itself, however, is rather complicated, and at best a yield of 60 to 80% is obtained.

There are other methods for the preparation of chlorine dioxide from sodium chlorite, and a preferred and convenient one is illustrated by the following equation:

$$NaClO_2 + Cl \rightarrow NaCl + ClO_2$$

This is a rather unexpected reaction and, of course, does not proceed as simply as this equation may indicate. There are a number of intermediate stages about which there is generally not much known except, perhaps, to the Mathieson Chemical Corp. which has studied this problem intensively.

It was found that, by making sodium chlorite available to the trade, opportunity was given to the industry of working with chlorine dioxide. It did not take long before this opportunity was utilized for various purposes, chiefly bleaching of textiles, fats, and oils, and a little later, also for the bleaching of flour and taste and odor removal from domestic water. The two last applications have extended considerably during the past few years, and it is believed that there are now about 150 American cities which sterilize and deodorize their water by means of chlorine dioxide. As far as bleaching of flour is concerned, this new agent already has a monopoly.

Now, if you will visualize the various steps that are being taken in order to bring the chlorine dioxide into the bleaching vessel of a pulp or paper company, you will at once realize that there are some detours of almost grotesque dimensions.

First, chlorine dioxide is made out of chlorate and is reduced from the electrically neutral molecule to the negatively charged ion which means that one of its oxidation equivalents has to be destroyed. This reduction requires close supervision as it, otherwise, is liable to overshoot the mark. Then this ion is combined with caustic soda in aqueous solution which is

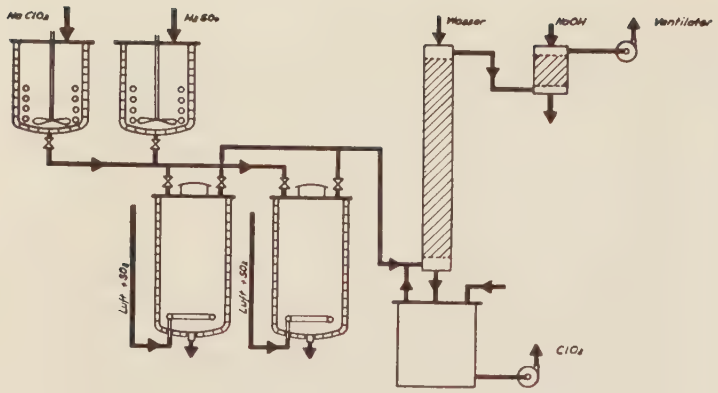

Fig. 1. The Holst process

then evaporated in order to get a solid salt. The salt is packed into rather expensive containers, sent to the user who promptly redissolves it in water and reoxidizes it with more chemicals, such as an acid or chlorine, with a yield which is below 80%. If the chlorine dioxide costs are figured as it is being formed at the place of ultimate usage compared to the cost of that chlorine dioxide which the original manufacturer had already produced, it is found that all these intermediate manipulations have increased its cost by about 600%.

It is conceivable that some industries which manufacture high-priced products and which use only small amounts of chlorine dioxide per ton or per pound of their product, as for instance the textile industry, can put up with such conditions. However, if we deal with mass production of lower priced material, as for instance in the pulp industry, and if we need appreciable quantities of this chemical, it is quite clear that the use of sodium chlorite is severely restricted. Therefore, the company which bleaches continuously a large pulp tonnage must either forego the advantages of chlorine dioxide or manufacture it on its own premises. Fortunately, enough experience has been gained over the past years in the manufacture and handling of this compound that the idea of producing it right in the plant does no longer appear remote or dangerous, and one way will be shown in which this can be done conveniently, without danger, and at surprisingly low costs.

Perhaps we may leave, for a moment, the facts, and do some speculation and put forward the question whether chlorine dioxide, just as chlorine, cannot be produced in a special factory and transported in multiton containers or tank cars. This is a proposition which cannot be answered positively today. It is doubtful, but in no way impossible, that the serious difficulties may be overcome. Until that day arrives, you will have to manufacture the desired chemical in your own plants.

Concerning the making of chlorine dioxide, it is admitted that, so far, the process which should have the greatest attraction, namely the direct union of oxygen and chlorine, has not been made practical. We still have to proceed in a less direct manner, and have first to bring the chlorine to a high level of oxidation from which it is reduced. This higher level is that of the chlorates which, as all know, are quite stable products and are manufactured today on a broad basis. It is a fact that all processes for making chlorine dioxide use chlorate as the raw material and this is being reacted with strong acids, mostly sulphuric or hydrochloric.

The first step is the formation of chloric acid which also is quite stable provided its concentration is kept low. In the next stage, this chloric acid is reduced to chlorine dioxide, and it is a delicate operation which needs careful handling, not so much from a safety angle as from the point of view of directing the reduction along desired lines. Chlorine has the rather unfortunate ability to act on various levels of oxidation, and if we are not careful we may find that a considerable part of the chlorate will show up as chlorous acid, chlorine, or even hydrochloric acid. However, the problem does not consist exclusively of difficulties because, luckily enough, there are a number of reducing agents which are well suited, as long as they are not applied in excessive concentrations or at high temperatures. Many have been proposed for this purpose, and some of them are being used on commercial scale, as for instance hydrochloric acid, sulphur dioxide, coal, bivalent manganese, trivalent chromium, hydrogen peroxide, arsenous acid, starch, methyl alcohol, sugar, and oxalic acid, etc. The selection of any one of these reagents is not a chemical problem but depends mostly on the type of procedure which has been chosen.

The mechanism of this reduction is not simple and, in many cases, not yet clearly defined. It would lead us too far astray if we wanted to go into details. It might, however, be useful to give a very approximate survey of the technical processes that are used in Europe today. These are: (1) the Holst showing a close relation to the old I. G. Farben process; (2) the Persson process, and (3) the Kesting process as developed at Munich.

There have been good papers describing the first two methods, and the author shall therefore restrict himself to mentioning only their basic principles as far as they should be known to everybody who is interested in this matter, and to the extent that they have some connection with the description of the method being discussed.

Holst develops its chlorine dioxide through reduction of chloric acid with sulphur dioxide, and the chloric acid is first made from sodium chlorate and sulphuric acid. The reactions may be represented by the following two equations:

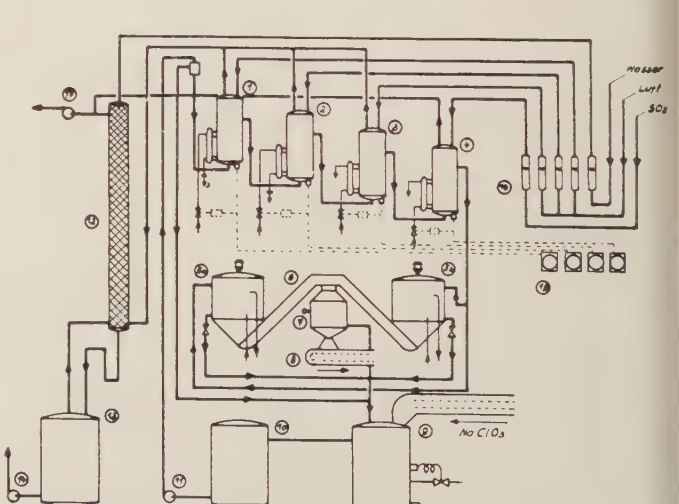

Fig. 2. The Persson process

$$2NaClO_3 + H_2SO_4 \rightarrow 2HClO_3 + Na_2SO_4$$
$$2HClO_3 + SO_2 \rightarrow 2ClO_2 + H_2SO_4$$

he chief reaction illustrated by the second equation
ve is, however, accompanied by another process
h yields chlorine instead of chlorine dioxide.
efore, what is really obtained in actual practice
lorine dioxide contaminated with chlorine.

cording to publications, this Holst process is a
n procedure, but there has been some indication
y of its perfection into continuous operation. The
materials are: solid sodium chlorate (which later
s dissolved in water), sulphuric acid, and sulphur
de. The reaction proceeds at temperatures of
t 40 to 50°C., and leads to fairly complete con-
otion of the sodium chlorate. At the end, a so-
n consisting chiefly of sodium sulphate and excess
huric acid with small amounts of unreacted chlo-
is obtained and this solution is used in sulphate
mills for the decomposition of soap skimmings.
gas leaving the reactors contains about 10% chlo-
dioxide and is directed into stoneware towers filled
Raschig rings where water is running down
tercurrently. Finally a solution containing about
ams chlorine dioxide per litter is obtained. This is
cted in a storage tank and pumped from there to
bleachery. The air current which leaves at the
of the absorption column contains residual chlorine
ide, and it has been found of benefit to absorb these
es in caustic soda solution.

n some respects, the Persson procedure may be con-
red as an improvement inasmuch as such portions
sodium chlorate that have not reacted do not need
be discarded. The recovery of this remaining so-
m chlorate is achieved by cooling the solution at
end of the chlorine dioxide development, and this
perature drop causes the crystallization of the
ium sulphate, whereas all sodium chlorate still
sent remains dissolved. Therefore, after separation
he solid sodium sulphate from the liquor by cen-
uging, this liquor can be strengthened again by ad-
on of solid sodium chlorate. Thus, it may be seen
t here is a closed reaction cycle.

nother difference from the Holst process is the use of
talyst. It has already been mentioned that chloric
d can easily be reduced by various agents and that
se reducing agents do not all act alike. Some of
m lead to undesired side reactions, whereas others
not. The inventor of the Persson process has

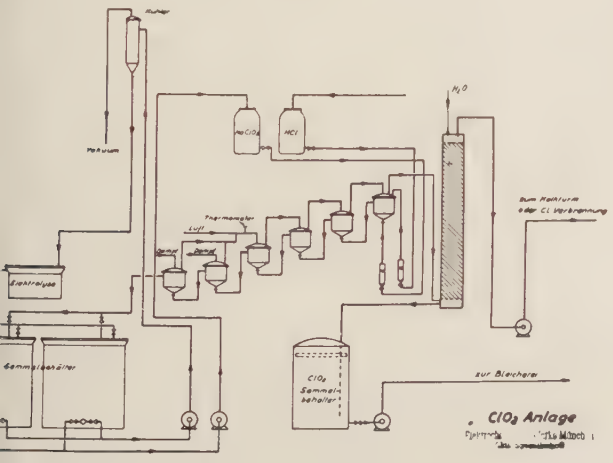

Fig. 3. The Kesting process

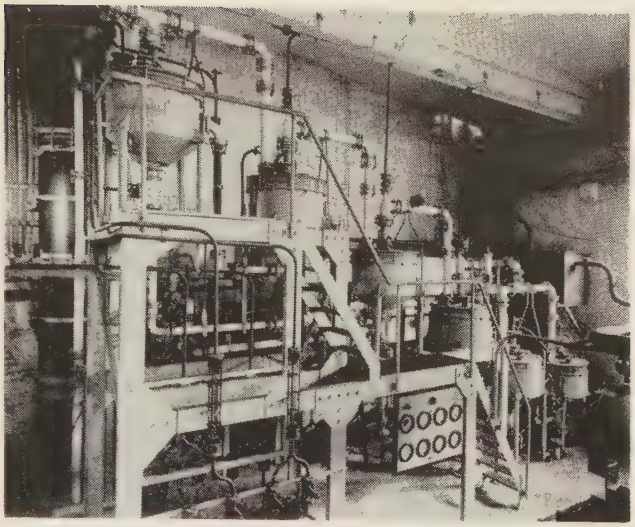

Fig. 4. Reaction vessels in the Kehlheim plant of Zellstoff Waldhof

found a very suitable catalyst in the form of trivalent chromium, and the reactions may be represented by the following equations:

$$6NaClO_3 + Cr_2(SO_4)_3 + H_2O \rightarrow 6ClO_2 + H_2Cr_2O_7 + 3Na_2SO$$
$$H_2Cr_2O_7 + 3SO_2 \rightarrow Cr_2(SO_4)_3 + H_2O$$

which may be summarized:

$$6NaClO_3 + 3SO_2 \rightarrow 6ClO_2 + 3Na_2SO_4$$

It is easily seen that by combining the two upper equations a third one is obtained which is just the same as that given for the Holst process. The chromium compound acts as a catalyst which is not used up, and its consumption is, therefore, negligible. One of the most important features of the Persson process is that the reaction leading to the chlorine dioxide does not start until a certain temperature is reached, and the adjustment of the temperature can be used for controlling the process.

It has been stated that the maintaining of the correct acid concentration is of great importance because it influences the form of the crystals in which the sodium sulphate is obtained, and it is also necessary to avoid the formation of bisulphate. An important prerequisite for this is sufficient cooling, and temperatures in the range of 5 to 8°C. or lower must be reached. The choice of construction material is quite limited, and lead and monel appear to be preferred. It is estimated that three quarters of the chlorine dioxide costs are due to the cost of solid sodium chlorate.

Summarizing, both methods are based on the same principles. Sodium chlorate is dissolved and reacted with sulphuric acid. The chloric acid thus formed is reduced with sulphur dioxide, either directly or by means of a catalyst. Theoretically, pure chlorine dioxide should be obtained. In practice, this is not the case, and the gas always contains small percentages of chlorine.

We, at Munich, have chosen a way which is different in principle from those just described and the author wishes to mention here that the Brown Co. of Berlin, N. H., has worked out a similar process for which United States and Canadian patents have been issued but this modification is not yet applied on an industrial scale.

It was realized that if it is not absolutely essential to

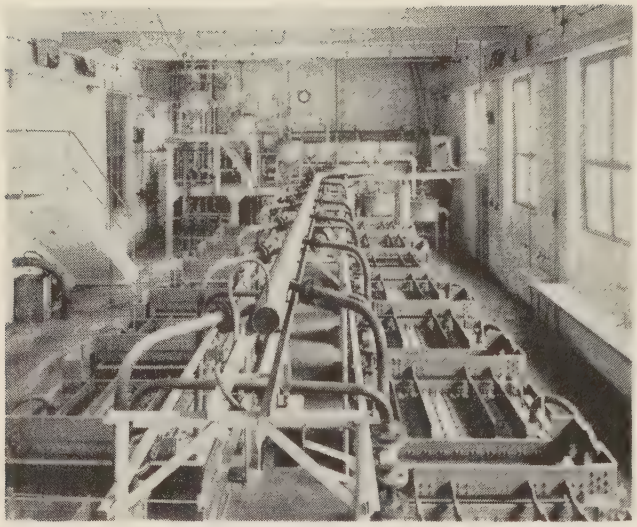

Fig. 5. The electrolysis section at the Kehlheim plant

have chemically pure chlorine dioxide, and if the separation of chlorine from chlorine dioxide is simple, then perhaps too much effort should not be spent in trying to make pure chlorine dioxide. It is recollected that it is easy to prepare a mixture of chlorine and chlorine dioxide by reducing chloric acid with hydrochloric acid according to the equation:

$$NaClO_3 + 2HCl \rightarrow NaCl + ClO_2 + Cl + H_2O$$

Admittedly these two reagents may also act upon each other in a different way, and there is a side reaction according to the equation:

$$NaClO_3 + 6HCl \rightarrow NaCl + 6Cl + 3H_2O$$

giving a lot of chlorine but no chlorine dioxide. To be successful, this second reaction must be suppressed and, looking at the formulas, it can be seen immediately that this can be done by using small amounts of hydrochloric acid. In practice, therefore, the hydrochloric acid addition is limited to about 50% of what the first equation requires, and in that way the reaction of the second equation will have little chance to proceed. It is furthermore obvious that, in this way, a good yield is obtained with regard to oxidation of hydrochloric acid. On the other hand, a lot of sodium chlorate will be left over at the end of the reaction. Now, it goes without saying that this unreacted sodium chlorate cannot be thrown away, and a way to utilize it again must be found. One method would be to concentrate the remaining solution by evaporation. It contains sodium chloride and sodium chlorate, also small amounts of hydrochloric acid. Sodium chloride, because it is much less soluble than sodium chlorate, will crystallize out on evaporation.

This whole method has been known to the chlorate manufacturers for over 50 years and really does not entail any difficulties. After completion of this evaporation and isolation of the solid sodium chloride, water and new sodium chlorate may be added and the solution brought, in that way, to the original condition. Consequently, the process would be something similar to the Persson process with the difference that solid sodium chloride would be obtained, whereas the Persson process gives solid sodium sulphate.

However, this was not quite satisfactory and therefore a decisive step further was made. The solution at the end of the reaction contains sodium chloride and sodium chlorate. Now it is known that sodium chlorate is manufactured industrially by oxidizing a sodium chloride solution in an electrolytic cell. Therefore, if the solution is placed in a chlorate cell and current passed through it, the sodium chloride is stepped up to chlorate whereas nothing happens to the chlorate which is still present. Therefore, this process can be interpreted as a decomposition of water whereby its oxygen combines with the sodium chloride to form sodium chlorate and the hydrogen escapes into the air. If this process is added, the following relations are obtained:

$$\overset{\downarrow}{2NaClO_3} + 2HCl \rightarrow ClO_2 + Cl + H_2O + \overline{NaCl + NaClO_3}$$

(Electrolysis)

It will immediately be seen that the system needs to be filled with sodium chloride only once. This sodium chloride solution is never consumed and just circulates around continuously. In the electrolytic cell it absorbs oxygen and is converted into chlorate, and it leaves the chlorine dioxide reactors partly as chlorate and partly as sodium chloride which in turn is reoxidized in the electrolytic cell. The sodium chloride solution acts merely as a transmitter of oxygen. The function of the oxygen is to oxidize the hydrochloric acid to chlorine and chlorine dioxide. Therefore, it is important to point out that the chlorine dioxide comes from hydrochloric acid, water, and electric current.

The great advantage of this method is, first of all, cooling and centrifuging which are both rather difficult on account of the corrosive nature of the solutions can be omitted. Second, and this seems to us a most important point, it is very much cheaper.

As already mentioned, sodium chlorate is always manufactured by electrolysis, and one usually arrives at a solution which contains about 400 grams per liter chlorate, 80 to 100 grams per liter chloride and, besides this, small amounts of sodium bichromate which are necessary for the good performance of the electrolytic process. The chlorate manufacturer is now in the difficult position of concentrating this solution by evaporation and separating the chlorate from the chloride and the bichromate by fractionated crystallization. Then, the chlorate has to be purified by a second crystallization. Both processes are rather expensive.

To illustrate the conditions a little more clearly, the author may say that at present 1 kg. of solid sodium chlorate costs, in Germany, 1 mark. The cost of this same kilogram of sodium chlorate in the original solution, however, was only half a mark or maybe less. While all other methods for manufacturing chlorine dioxide require pure solid sodium chlorate as raw material, the Kesting Process utilizes raw brine as it comes from the electrolytic cell can be utilized. Furthermore, 75% of the cost of the chlorine dioxide is due to the price of sodium chlorate, consequently this 75% can be reduced by half so that the total costs do not exceed 60% of the chlorine dioxide made according to other processes.

The process may be described schematically, as follows: A battery of six reaction vessels is arranged cascadelike. In the first installations stoneware pots protected by an outer steel shell were used. Lately

iron containers lined with the plastic Opanol and then tiled have proved very satisfactory. Chlorate solution and hydrochloric acid, coming from headboxes, flow through these pots, step by step by gravity, and the discharge from the last vessel is collected in a large storage tank. It is then circulated between this tank and the electrolytic cell until all, or the desired quantity, of the sodium chloride has been oxidized to chlorate.

There are two of these large storage tanks, or preferably three, the reason being that there must always be a reasonable volume of chlorate solution on hand to keep the chlorine dioxide section functioning, and the third one is needed for collecting the exhausted solution coming from the chlorine dioxide reactors so that there is no interference with that solution which is just being fortified.

A stream of air is sucked in countercurrently through the installation. It enters through the chlorine dioxide water storage tanks, thus sweeping away any liberated chlorine dioxide, and passes then through the battery and is finally discharged through the exhaust pump installed behind the washing tower. This air serves the triple purpose of agitating the contents of each reactor, of removing the formed chlorine and chlorine dioxide, and of diluting the latter to safe partial pressures.

This gas mixture leaves the reaction train from the top of the pot at highest elevation and is directed into a tower of very simple construction where the chlorine is separated from its dioxide. This separation is not too difficult and is performed by a water wash. Because of its high solubility the chlorine dioxide goes into aqueous solution and concentrations in the neighborhood of 5 grams chlorine dioxide per liter, equivalent to about 13 grams per liter active chlorine, are obtained. This solution is ready for immediate use in the bleachery.

A mixture of chlorine and air escapes from the top of the separating tower and may be utilized for formation of hypochlorite through reaction with alkali, or for making hydrochloric acid by combustion with the hydrogen of the electrolysis.

Experience has shown that hydrochloric acid will react completely even with an excess of chlorate, only at elevated temperature. However, high temperature in the initial stages must not be applied because of the great danger from explosions. On the other hand, there is no objection against raising the temperature in the final stages of the system because only small amounts of chlorine dioxide are being set free there, and the concentration is low. Consequently, a temperature gradient can be set up with operations say at, 20, 40, 60, 80, and 100°C. These temperatures merely serve as an example and should not be accepted as actual operating data. This temperature gradient is established by adding steam to the two lowest reactors (nos. 6 and 5) and the escaping vapors are led into the air stream which enters the preceding reactor (no. 4). A thermometer, indicating or recording, measures the temperature of the air and vapor mixture as it enters this fourth reaction vessel. It is this thermometer which governs the operation of the whole unit as the constant air flow together with the constant liquor flow creates quite definite and well-defined temperatures through condensation of its vapor in the next higher reactor.

During the electrolytic fortification of the partially depleted brine, some heat is set free and it is necessary to cool the electrolyte. This problem has been solved in a rather elegant manner, by installing a small vacuum cooler in which the temperature of the electrolyte is lowered by evaporation of some of its water. This leads automatically to a concentration of the solution which is desirable with regard to the liquor volume balance because it has been found that it permits the use of aqueous hydrochloric acid rather than anhydrous, as it just compensates for the volume increase brought in by this acid and by steam condensate. Thus, no special evaporating equipment and steam for the concentration of the solution, nor a cooler and cold water for lowering the temperature of the electrolyte is needed.

Several large-scale installations have already been built, and two others are just ready for start-up. One fairly large unit is being operated by Zellstoff Waldhof in their Kehlheim plant, since the beginning of 1951, and has given great satisfaction.

As with everything else, the costs are a function of many variables and can, therefore, not be given in one single figure. Just as in the manufacture of chlorine; power costs, wages, and capacity of the installation play a vital part. However, a few data are given which will make it possible to form a reliable opinion.

The Munich process requires per pound of chlorine dioxide about 0.55 lb. of chlorine and 6.37 kw.-hr. and considering the cost figures now prevailing in Germany, which are believed to be in some respects higher than those in the United States, 1 lb. of chlorine dioxide is being made presently for 0.68 DM, equivalent to about 16 U. S. cents. Considering further that 1 lb. of chlorine dioxide is chemically equivalent to 2.63 lb. active chlorine, we arrive at 6.1 U. S. cents per lb. of active chlorine in the chlorine dioxide. This compares with the equivalent of about 2.7 U. S. cents for elemental chlorine liquid in tank cars, f.o.b. manufacturer. In countries where power costs are relatively low, the chlorine dioxide costs are lower also, and in one Scandinavian pulp mill this process delivers chlorine dioxide for the cost of the equivalent amount of chlorine in the form of bleach liquor.

Even in Germany, where power costs are high and the pulp-producing units of capacities small in comparison to American plants, the use of chlorine dioxide in pulp bleaching increases the cost per ton of pulp by only 70 U. S. cents, which is very little in view of the quality improvements that are gained.

Therefore, very luckily, the time has now come when the pulp maker can enjoy the outstanding advantages of chlorine dioxide bleaching without increasing his manufacturing costs appreciably, and such small increase as may show up is balanced several times by better quality.

It has also been mentioned that chlorine dioxide may reduce the pulp shrinkage during bleaching. However, these and other details of pulp bleaching do not belong in the frame of this paper. The author prefers to leave this to the pulp and paper engineers and chemists, and imagines that they will soon deal with this problem.

Acknowledgment is made to Ferdinand Kraft, Marathon Paper Mills of Canada, Ltd. for the translation of this paper into English.

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On the Mechanism of Sulphur Dioxide Absorption in Aqueous Media

ROY P. WHITNEY, S. T. HAN, and J. LAWLOR DAVIS

This paper discusses the absorption of sulphur dioxide in several aqueous media of interest in the pulp and paper field. When the absorption is conducted in a packed tower, and interpreted in the light of the two-film theory, it is shown that the absorption mechanism varies greatly with the characteristics of the absorbent. For the sulphur dioxide–water system, both film resistances are known to be important. When the absorbent is a strongly alkaline sodium carbonate solution, the resistance is essentially all in the gas film. In sodium bicarbonate and sodium sulphite solutions the controlling resistance shifts toward the liquid film. The implications of these conclusions in design are pointed out.

THE unit operation of gas absorption finds application in many industries of which the pulp and paper industry is one. Here, gas absorption techniques are employed in varied instances of mass transfer between phases, particularly in the preparation of cooking liquors and bleaching solutions, and in the recovery of valuable components from gaseous mixtures. In the pulp and paper field, the two gases most commonly encountered in absorption are probably sulphur dioxide and chlorine, and the most common absorption equipment is a packed tower. The absorption of these gases in water has been studied quite comprehensively (*1*, *2*), but our understanding of the more complex cases is very limited. It is the object of this paper to discuss the application of the present theory to the available data on the absorption of sulphur dioxide in several aqueous media.

The present working hypothesis of absorption mechanism is the two-film theory, proposed originally by Whitman (*3*) in 1923. While it is evident that some of the assumed conditions of the two-film theory can apply only approximately to a packed tower (*4*), nevertheless remarkable success has been achieved through its application in design. Although other approaches are of current interest, there is at present no better theory adequately developed for design purposes.

According to the two-film theory, the resistance to transfer is considered to be concentrated in two fluid films, one of gas and one of liquid, in contact at the gas-liquid interface. The two phases are assumed to be in equilibrium at the interface, the equilibrium relation being the solubility of the gas in the liquid. If the partial pressure of the solute gas is p in the main body of the gas, and p_i at the interface, then transfer takes place through the gas film because of the pressure gradient $(p - p_i)$. Similarly, under steady-state conditions, transfer takes place at the same rate through the liquid film, because of the concentration gradient $(C_i - C)$, where C_i and C are the concentrations of solute at the interface and in the main body of the liquid. This concept is expressed mathematically as

$$\text{Rate of absorption} = k_G(p - p_i) = k_L(C_i - C) \quad (1)$$
$$= \text{moles absorbed per unit time per unit interfacial area}$$

The terms k_G and k_L represent the reciprocals of the transfer resistances in the gas and liquid films, and are called film coefficients.

Since it is difficult to measure the interfacial area in a packed tower, it is customary to introduce a factor a, defined as the effective area available for transfer per unit volume of packing. The term a is usually combined with the coefficients to yield k_Ga and K_La, also called film coefficients but based on a unit volume of packing.

Furthermore, because it is not feasible experimentally to measure conditions at the interface, the film coefficients defined by equation (1) cannot be determined directly. For design purposes they are replaced with over-all capacity coefficients on a volume basis, k_Ga and K_La, which combined the resistances of both films into one quantity. The associated driving force must accordingly be that across both films, from the main gas body to the main liquid body.

When these substitutions are made in equation (1) and when it is applied to a differential height (dh) of a tower of unit cross section, the following expressions result:

$$dN = K_Gadh(p - p_e) = K_Ladh(C_e - C) \quad (2)$$

where dN is the differential transfer rate, usually expressed in pound moles per hour per square foot of tower cross section. Evidently, p_e is the equilibrium partial pressure of the solute gas corresponding to the main liquid body concentration C, and likewise, C_e is in equilibrium with p. It is also evident that the coefficients K_Ga and K_La are two representations of the same specific transfer rate, expressed in gas and liquid film units, respectively.

For cases where the equilibrium solubility relation for the system can be expressed by a linear function, such as Henry's law,

$$C_i = Hp_i; \qquad C_e = Hp; \qquad C = Hp_e \quad (3)$$

the film and over-all coefficients are related as follows

$$\frac{1}{K_La} = \frac{1}{k_La} + \frac{H}{k_Ga} = \frac{H}{K_Ga} \quad (4)$$

For other cases, the use of over-all coefficients is not strictly valid, the degree of doubt depending upon the extent of the deviation from the linear solubility relation.

It is to be noted that the over-all capacity coefficients K_Ga and K_La are essentially empirical. They vary with any of the many factors which may affect the film

ROY P. WHITNEY, Research Associate; S. T. HAN, Technical Associate; and J. LAWLOR DAVIS, Technical Assistant, The Institute of Paper Chemistry, Appleton, Wis.

efficients, the interfacial area, or the solubility relation, and must therefore be used with caution. It seems evident that progress with the film theory must come through a better understanding of the film coefficients.

Over-all coefficients are measured in towers of known dimensions, so chosen as to make possible accurate determinations of the driving forces at the top and bottom of the packing. Since the relations given above apply only to a differential tower height, they must be integrated between the appropriate boundary conditions. For the cases to be discussed this integration results in the following forms, involving the logarithmic mean driving force at the top and bottom of the packing:

$$N = K_G a h(p - p_e)_{l.m.} = K_L a h(C_e - C)_{l.m.} \qquad (5)$$

The rate of transfer N is determined from a material balance. The details of using these relations in design calculations have been discussed in a previous paper [ ].

Even though the film coefficients cannot be measured directly, several techniques have been evolved for their determination. For example, equation (4) suggests that, with a very soluble gas (H very large), $K_G a$ approaches $k_G a$ in magnitude. Thus, the gas film resistance controls the rate of absorption, and measurements of $K_G a$ yield also values of $k_G a$. Similarly, with a very insoluble gas (H very small), the liquid film resistance controls, and $K_L a$ and $k_L a$ become nearly the same. In some cases, one or the other film resistance can be subordinated through the judicious choice of operating conditions. Another technique which has been used is to bring about a rapid and irreversible chemical reaction in the liquid, rapidly removing the solute from the liquid film, and thus causing the transfer rate to be controlled by the gas film resistance. Simultaneous absorption and chemical reaction is complex, however, and it is only in rare cases that gas film coefficients can be measured by this technique. This will be discussed further below.

The characteristics and the magnitude of liquid film coefficients have been better established than for gas film coefficients. For pure physical absorption, liquid film coefficients increase strongly with the liquor rate, are independent of gas rate, and increase markedly with temperature (*6*). From the data available, gas film coefficients appear to be a strong function of the gas rate and, when expressed on the volume basis, also increase mildly with the liquor rate (*4*). The effect of temperature on gas film coefficients is generally believed to be negligible, at least in the range of room temperature.

SULPHUR DIOXIDE ABSORPTION

Several systems involving the absorption of sulphur dioxide are of general interest in the pulp and paper field. These vary markedly in the absorbent solutions used, which range from a strongly alkaline to a strongly acid condition. It is desired to discuss some of these systems, and since the best understood is the absorption of sulphur dioxide in water, this will be considered first.

The most extensive data on the sulphur dioxide–water system are those of Whitney and Vivian (*1*), obtained in an 8-in. diameter tower packed with 1-in. ceramic Raschig rings. Their data show that, for this

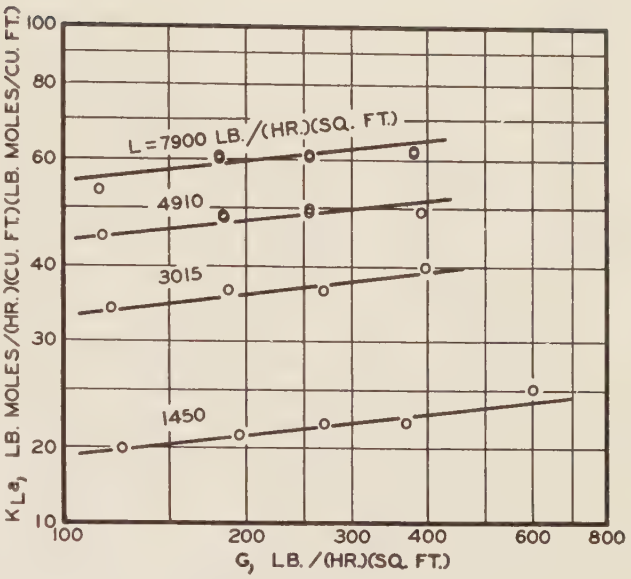

Fig. 1. Absorption of sulphur dioxide in water

90°F., 1-in. Raschig rings.

system, both film resistances play an important part. In addition to providing over-all coefficients for design, these data were analyzed to yield expressions for individual gas and liquid film coefficients. The resulting liquid film coefficients were lower than would be predicted from the generalized correlation of Sherwood and Holloway (*6*) probably because of complications introduced by the hydrolysis of sulphur dioxide in water.

In the course of absorption studies in progress in this laboratory, additional data have been obtained on the sulphur dioxide–water system, at a temperature of 90°F. The tower was 4 in. in diameter, packed with 2 ft. of 1-in. ceramic rings. The data are presented in Fig. 1.

The effect of gas and liquor rates on the over-all coefficients of Fig. 1 is practically the same as shown by the earlier data of Whitney and Vivian. However, the present coefficients are approximately 20 to 25% higher in magnitude, probably indicating a difference in the effective interfacial area a. The actual interfacial area is usually far removed from the dry surface area of the packing, depending upon the liquor rate, liquor distribution, and tower and packing dimensions. In this case, the higher level of values of the over-all coefficients, compared with those of Whitney and Vivian, may well be attributed to the low ratio of tower-to-packing diameter, and the attendant large wall effect. The coefficients of Whitney and Vivian are undoubtedly more reliable for design purposes.

The major function of the present sulphur dioxide–water data is to provide a base line for comparison with the data for the other systems to be discussed. Because of the small tower diameter, as discussed above, and because of the vagaries of packed towers in general, analysis and interpretation of coefficients should be confined to one tower and one experimental technique.

Using the method previously described by Whitney and Vivian (*1*), it is possible to break down the over-all coefficients of Fig. 1 into gas film and liquid film coefficients. This is accomplished by application of the general approach first proposed by Wilson (*7*) for heat transfer, in which the reciprocal of the over-all co-

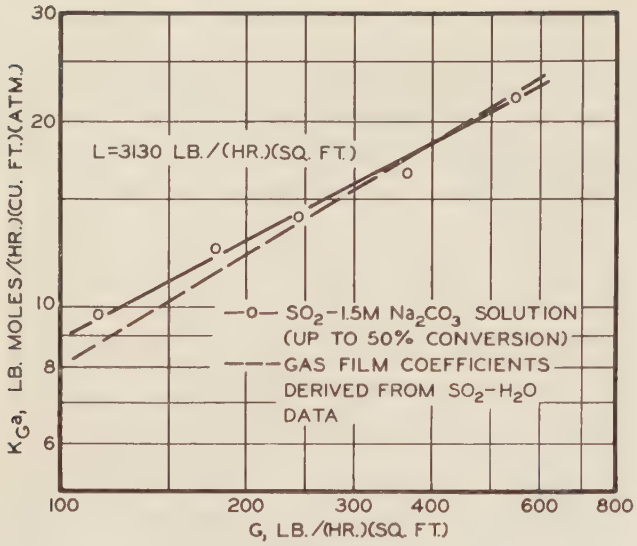
L=3130 LB./(HR.)(SQ. FT.)
—o— SO_2–1.5M Na_2CO_3 SOLUTION (UP TO 50% CONVERSION)
——GAS FILM COEFFICIENTS DERIVED FROM SO_2–H_2O DATA
K_Ga, LB. MOLES/(HR.)(CU. FT.)(ATM.)
G, LB./(HR.)(SQ. FT.)

Fig. 2. Absorption of sulphur dioxide in sodium carbonate solution

100°F., low-range conversion, 1-in. Raschig rings.

efficient is plotted against the reciprocal of the gas rate raised to a fractional power, the exponent being determined by trial as that required to yield a linear function. By correlation of the slopes and intercepts of the resulting straight lines, algebraic expressions for the two film coefficients are obtained. For the data shown in Fig. 1, such analysis yields the following two expressions for the gas and liquid film coefficients:

$$k_Ga = 0.026G^{0.6}L^{0.37} \quad (6)$$

$$k_La = 0.095L^{0.77} \quad (7)$$

These expressions obviously are based on data obtained at 90°F. The effect of temperature on gas and liquid film coefficients is discussed below.

When sulphur dioxide is absorbed in a sodium carbonate solution, the following chemical reactions might be expected to occur:

$$2Na_2CO_3 + SO_2 + H_2O = 2NaHCO_3 + Na_2SO_3 \quad (8)$$

$$2NaHCO_3 + 2SO_2 + 2H_2O = 2NaHSO_3 + 2CO_2 + 2H_2O \quad (9)$$

$$Na_2SO_3 + SO_2 + H_2O = 2NaHSO_3 \quad (10)$$

Reaction (8) occurs in a pH range between about 11 and 9, whereas reactions (9) and (10) take place in a pH range of about 9 to 5. Because of this difference in the alkalinity of the absorbent solutions, changes in the absorption mechanism might be expected. Accordingly, experiments were conducted in the 4-in. tower mentioned above to investigate these two conversion ranges.

Figure 2 shows over-all coefficients obtained by the absorption of sulphur dioxide in 1.5 molar sodium carbonate solution. The data cover a range of gas rates from 115 to 550 lb. per hr. per sq. ft., at a constant liquor rate of 3130 lb. per hr. per sq. ft., and an average liquor temperature of 100°F. In all runs, the stoichiometric relations were such that the sulphur dioxide absorbed was never more than 50 mole per cent of the sodium carbonate supplied. Thus, in this range, the major conversion might be represented by reaction (8). However, that this probably represents an oversimplification is indicated by the experimental observation that carbon dioxide is evolved, to a substantial extent, even in this low conversion range. The detailed mechanism of this evolution of carbon dioxide remains to be investigated.

In this case, absorption is accompanied by a chemical reaction between a strong base and a relatively strong acid. The reaction would be expected to be rapid and irreversible and thus to remove sulphur dioxide rapidly from the liquid film. If such is the case, the experimental values for K_Ga should approach in magnitude the gas film coefficients, k_Ga, derived from the sulphur dioxide–water data. This comparison is made in Fig. 2, where the broken line represents the gas film coefficients calculated from equation (6) at a liquor rate of 3130 lb. per hr. per sq. ft. The agreement between the two appears to justify the conclusion that, in this stage, the absorption rate is controlled by the gas film resistance.

In further experiments in the 4-in. tower, the stoichiometric ratio of sulphur dioxide to sodium carbonate was increased step-wise to a maximum of 120%. The data are shown in Fig. 3 for two series of runs of different liquor rates but the same rate of sodium carbonate input. In this range, presumably reaction (8) goes to completion, and reactions (9) and (10) proceed to varying extents. Thus the over-all coefficients determined experimentally must reflect the gross result of all these reactions. It is evident from Fig. 3 that in the high range of conversion, the absorption and reaction mechanisms are changing. While, at the lowest gas rate, the coefficients are still characteristic of the gas film, it appears that the liquid film resistance becomes more important as the conversion proceeds further. This is indicated by the leveling off and finally the decrease in the over-all coefficients.

Qualitatively, the conversion can be visualized as taking place in two stages. Taking the data of Fig. 2 as representing the first stage, with those of Fig. 3 for both stages, coefficients for the second stage alone can be estimated. At a liquor rate of 1550, the over-all coefficient for the second stage is in the neighborhood of 4, varying little with gas rate.

It appears that the behavior of the system in the second stage bears some similarity to the behavior of the carbon dioxide–sodium carbonate system (*8*, *9*)

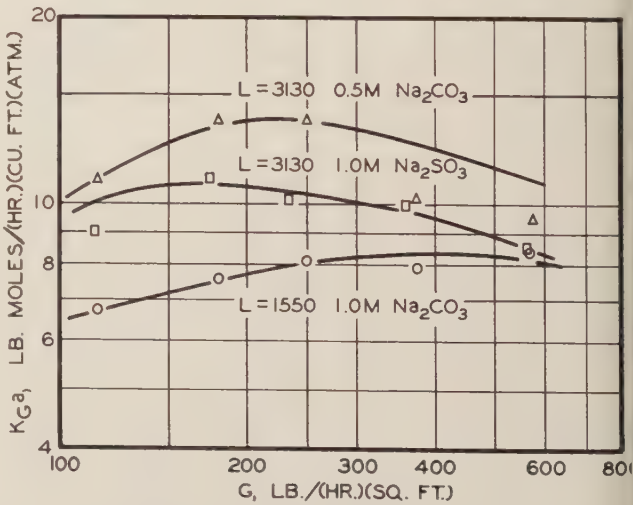

Fig. 3. Absorption of sulphur dioxide in sodium carbonat and sodium sulphite solutions

100°F., high-range conversion, 1-in. Raschig rings.

When carbon dioxide is absorbed in sodium carbonate solution, the resistance, contrary to what might be expected, is largely in the liquid film. The over-all coefficient, K_Ga, has been found to decrease with increasing conversion. One difference between this system and the sulphur dioxide–sodium carbonate system should be noted, however. There is known to be an appreciable back pressure of carbon dioxide over the carbonate-bicarbonate solution. With the present system, there is believed to be little, if any, back pressure of sulphur dioxide over sulphite-bisulphite-bicarbonate solutions.

It has been noted that the sodium carbonate data of Fig. 3 represent the composite effect of two stages of conversion. It should be possible to eliminate the first stage effect by the use of sodium sulphite solution as the absorbent. The data obtained in such a series of experiments are also shown in Fig. 3. The data are not strictly comparable with the sodium carbonate values at the same liquor rate because of the difference in concentration. However, the general trend appears to be in agreement with the above discussion. The coefficients decrease more rapidly with increasing gas rate, but do not reach the terminal value of about 4 as predicted above. Sufficient data are not available for further analysis.

APPLICATION OF THE DATA IN DESIGN

In the pulp and paper field the absorbents of most general interest for sulphur dioxide are solutions of either hydroxides or carbonates. One or more of three stages of conversion may be involved, depending upon the type of liquor desired. The stages correspond roughly to (1) conversion of hydroxide or carbonate to sulphite, (2) conversion of sulphite or bicarbonate to bisulphite, and (3) build-up of free sulphur dioxide. It is evident from the discussion above that, from an absorption standpoint, these stages are best considered separately. The required packed height for each stage may be calculated, using the appropriate over-all coefficient. These heights may then be combined to yield an over-all tower height, or separate towers may be used.

For the first stage, either the over-all coefficients of Fig. 2 or equation (6) for gas film coefficients may be used for either sodium or ammonia-base liquor. In the case of calcium or magnesium-base liquor, these coefficients may be somewhat too high because of the low solubilities of some of the components present. The effect of temperature on this stage is small.

For the second stage, in view of the meager data available, only approximate calculations can be made. If the above interpretation of the data is correct, an over-all coefficient, K_Ga, of about 4, at a liquor rate of 1500 lb per hr. per sq. ft. and a concentration range of 0.5 to 1.0 molar, may be taken as a conservative basis of estimation. It is suggested that this coefficient be assumed to vary with the liquor rate raised to the one-third power, by analogy with the carbon dioxide–sodium carbonate system. Also, by analogy, the generalized effect of temperature on liquid film coefficients (6) may be used for this case. The relation is

$$k_La\alpha e^{0.023t}, \text{ where } t \text{ is in °C.} \qquad (11)$$

This procedure is probably applicable to all four bases mentioned above. Also, for all the bases, the recommended coefficients are probably sufficiently conservative that the effect of back pressure, if any, may be neglected.

For the third stage, the sulphur dioxide–water data of Whitney and Vivian (*1*) may be safely used, with the appropriate equilibrium solubility data. These data are available for calcium (*10*), magnesium (*11*), and ammonia-base (*12*) liquors. In the absence of data for sodium base the ammonia-base solubility can probably be used without serious error. The preparation of ammonia-base sulphite liquor has been discussed previously in detail (*5*).

It should be noted that all values of coefficients cited here apply only to the 1-in. ring packing used experimentally. For other types and sizes of packing more commonly employed commercially, adjustments in coefficient values are necessary. These can be made using the relative values cited by Sherwood and Pigford (*4*) based on both gas and liquid film coefficients.

NOMENCLATURE

a = interfacial area, sq. ft. per cu. ft. of packing
C = concentration of solute in the liquid, lb. moles per cu. ft.
C_e = concentration of solute in the liquid in equilibrium with solute gas of partial pressure p, lb. moles per cu. ft.
C_i = concentration of solute at the interface, lb. moles per cu. ft.
G = average total gas rate at top and bottom of tower, lb. per (hr.)(sq. ft. of tower cross section)
h = packed height, ft.
H = Henry's law constant, C/p, lb. moles per (cu. ft.)(atm.)
k_G = gas film coefficient, lb. moles per (hr.)(sq. ft.)(atm.)
k_Ga = gas film coefficient, lb. moles per (hr.)(cu. ft.)(atm.)
K_Ga = over-all coefficient expressed in units of the gas film, lb. moles per (hr.)(cu. ft.)(atm.)
k_L = liquid film coefficient, lb. moles per (hr.)(sq. ft.)(lb. moles per cu. ft.)
k_La = liquid film coefficient, lb. moles per (hr.)(cu. ft.)(lb. moles per cu. ft.)
K_La = over-all coefficient expressed in units of the liquid film, lb. moles per (hr.)(cu. ft.)(lb. moles per cu. ft.)
L = average liquor rate at top and bottom of tower, lb. per (hr.)(sq. ft. of tower cross section)
N = rate of solute transfer per unit cross section of tower, lb. moles per (hr.)(sq. ft.)
p = partial pressure of solute gas, atm.
p_e = partial pressure of solute gas in equilibrium with the liquid of solute concentration C, atm.
p_i = partial pressure of solute gas at the interface, atm.
t = liquor temperature, °C.

subscript:
$l.m.$ = logarithmic mean

LITERATURE CITED

1. Whitney, R. P., and Vivian, J. E., *Chem. Eng. Progress* 45, No. 5: 323 (May, 1949).
2. Vivian, J. E., and Whitney, R. P., *Chem. Eng. Progress* 43, No. 12: 691 (Dec., 1947).
3. Whitman, W. G., *Chem. & Met. Eng.* 29, No. 4: 146 (July 23, 1923).
4. Sherwood, T. K., and Pigford, R. L., "Absorption and Extraction," 2nd ed., New York, McGraw-Hill Book Co., Inc., 1952.
5. Whitney, R. P., and Han, S. T., *Tappi* 35, No. 12: 569 (Dec., 1952).
6. Sherwood, T. K., and Holloway, F. A. L., *Trans. Am. Inst. Chem. Engrs.* 36: 21 (1940).
7. Wilson, E. E., *Trans. Am. Soc. Mech. Engrs.* 37: 47 (1915).
8. Furnas, C. C., and Bellinger, F., *Trans. Am. Inst. Chem. Engrs.* 34: 251 (1938).
9. Payne, J. W., and Dodge, B. F., *Ind. Eng. Chem.* 24: 630 (1932).
10. White, C. K., Jr., Vivian, J. E., and Whitney, R. P., *Paper Trade J.* 126, No. 20: 46 (May 13, 1948).
11. Conrad, F. H., and Brice, D. B., *J. Am. Chem. Soc.* 70: 2179 (1948).
12. Marriner, D. E., and Whitney, R. P., *Paper Trade J.* 126, No. 21: 52 (May 20, 1948).

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Black Liquor Oxidation and the Absorption of Non-condensable Digester Gases

M. A. SCHOENING, L. W. SHEMILT, and R. H. WRIGHT

An experimental black liquor oxidation unit is described which is very compact and which can be made to effect substantially complete oxidation of the sodium sulphide in black liquor with complete absence of foaming. The spent air which issues from the unit carries no detectable amounts of hydrogen sulphide or methyl mercaptan. Digester gases after passage through a condenser to remove the greater part of the condensable material can be added to the air entering the oxidation unit and this serves to absorb substantially all the hydrogen sulphide and methyl mercaptan contained in these noncondensable gases. With correct operation of the oxidation unit, the addition of noncondensable digester gases to the air does not appear to impair the oxidation efficiency nor does it lead to a bad odor in the spent air leaving the unit. Calculation suggests that significant amounts of sulphur which would otherwise be lost can be retained in the system as a result of this procedure.

THE oxidation of sulphate black liquor while flowing down vertical sheets of refractory material was described in a previous communication (*1*). It was shown that by impressing a suitable surface pattern on the sheets the effectiveness of the surface may be increased and oxidation satisfactorily effected in a unit of comparatively modest dimensions. In order to test these conclusions and also to study the possibility of absorbing hydrogen sulphide and methyl mercaptan from noncondensable digester gases, a small, semipilot oxidation unit was constructed at the Bloedel, Stewart and Welch pulp mill at Port Alberni, B. C.

DESCRIPTION OF THE OXIDATION UNIT

Packing sheets of asbestos cement measuring $^1/_4$ by 24 by 48 in., were prepared by rolling the soft material between sheets of flattened expanded metal to produce the pattern of raised "diamonds" shown in Fig. 1. This work was carried out with the assistance of the Acme Asbestos Cement Co. of Vancouver, Canada, whose cooperation is gratefully acknowledged. The sheets were assembled in sets of five with two plane outer sheets by means of steel tie rods and asbestos cement washers. Six such sets were mounted vertically one above the other to give a column measuring 5 by 24 in. and 24 ft. high. This provided 480 sq. ft. of surface for black liquor oxidation. The whole column was enclosed in a galvanized iron housing (see Fig. 2). The unit was designed to handle about 3% of the black liquor normally produced in the mill.

The column was fitted with a black liquor distributor at the top, assembled from $^1/_4$-in. pipe suitably drilled and with a wooden air intake manifold surrounding th upper end. An orifice meter, thermocouple well, gat valve, and sampling cock were installed in the blac liquor feed line. At the bottom of the tower, the blac liquor leaving the plates flowed smoothly into a sum from which it was pumped to a tank in the recover plant. The air from between the plants passed int the upper part of the disengaging chamber from whic it was removed by means of a fan. Thermocouples an an orifice meter on the inlet manifold enabled the ai flow to be measured and controlled.

TOWER OPERATION

A number of runs were made using various blac liquor feed rates and for each feed rate two air-to-liquo ratios of approximately 40/1 and 20/1, volume/volume At no time was there any difficulty due to foaming an the spent air discharged from the unit gave negativ tests for hydrogen sulphide and methyl mercaptan It had none of the usual "kraft" odor.

The oxidized black liquor when analyzed colorimetri cally (*2*) gave a negative test for Na_2S. The blac liquor supply to the tower was taken from the pip leading from the strong filtrate tank to the weak liquo storage tank. In order to obtain sufficient pressure t bring the liquor to the top of the tower, it was necessar to by-pass the automatic level controller and throttl the outlet valve to the weak liquor tanks. Since th throttling could not be carried too far without floodin the filtrate tank, it was generally impossible to use fee rates much above 5500 lb. per hr. This limitation combined with a fall in the white liquor sulphidit during the period of the tests, prevented the feed rat from exceeding the predicted (*1*) break point of th unit (see Fig. 3). All that can be concluded therefore is that within the range of feed rates used in these test the unit gave complete oxidation as predicted, but th tests could not be extended so as to straddle the most in teresting range of feed rates where discharge of incom pletely oxidized liquor was to be expected.

ABSORPTION OF NONCONDENSABLE DIGESTER GASES

At the time these experiments were carried out th blow tank at Port Alberni was not equipped with a con denser or heat recovery system and the steam and blow gases were discharged directly to the atmosphere (*3*) In order to obtain a sample of the noncondensable frac tion of the blow gases a condenser was installed, capabl of handling about 3% of the total blow gases, i.e., it capacity was designed to match that of the oxidatio unit.

A used, single-pass, multitube heat exchanger wa purchased containing 92 effective 1-in. tubes 12 ft. lon

M. A. SCHOENING, Junior Chemist, British Columbia Research Council, present address, Sherritt-Gordon Mines Ltd., Ottawa, Canada; L. W. SHEMILT, Associate Professor of Chemical Engineering, University of British Columbia; R. H. WRIGHT, Head, Division of Chemistry, British Columbia Research Council, Vancouver 8, B. C.

Table I. Absorption of Noncondensable Digester Gases in Black Liquor Oxidation Un

Run no.	Chips	Air, c.f.m.	Noncondensable gas, c.f.m.	Black liquor feed, lb./hr.	Na_2S content of black liquor, g./l. To tower	Na_2S content of black liquor, g./l. From tower	Digester blown	Sampled	Gas To tower H_2S	Gas To tower $MeSH$	Gas From tower H_2S	Gas From tower $MeHS$
	Hemlock	21.2	7.5	6100	2.7	0.7	11:24–11:35	11:11–11:13	12	6,240	.	.
								11:14–11:16	...	6,000	.	.
								11:18–11:20	...	6,560	.	
								11:22–11:24	3	1,280	.	...
								11:26–11:27	...	320	..	...
10	Cedar	31	13.4	6020	2.9	0.6	14:34–14:44	11:30–11:33	...	3,480	..	16
								14:18–14:19	...	3,520	..	24
								14:28–14:29	16	4,960	.	.
								14:33–14:34	...	...	..	
	Fir	21.5	7.3	5860	2.3	0.4	20:53–21:07	14:41–14:42	12	...	.	.
								20:50–20:51	10	1,940	.	.
								20:55–20:56	24	9,440	.	..
								20:59–21:00	28	9,920	.	. .
								21:06–21:07	32	15,760	.	...
	Hemlock	21	7.0	5350	2.3	0.3	09:23–09:43	09:25–09:27	8	9,840		..
								09:32–09:33	20	12,800	.	. .
								09:36–09:37	16	12,600	..	..
								09:42–09:43	16	6,400	..	...
	Fir	30.2	13.5	Nil	...	...	11:37–11:49	11:37–11:38	82	3,680	96	1840
								11:42–11:43	140	7,840	92	1680
	Hemlock	19.4	3–6	5380	2.4	0.4	14:25–14:36	14:26–14:27	52	4,480	10	192
								14:29–14:31	52	5,200		
								14:33–14:35	56	4,240	10	152
	Fir	28.7	13.8	5360	2.7	0.6	15:42–15:52	15:41–15:42	...	240	..	...
								15:44–15:45	216	9,920	.	...
								15:48–15:49	300	8,800	..	...
	Fir	19.4	3–6	5290	3.0	0.6	17:15–17:27	17:08–17:10	16	4,320	..	60
								17:15–17:17	8	2,820	..	...
								17:19–17:20	16	2,160	2	48
								17:22–17:24	32	5,040	2	48

l giving about 300 sq. ft. of transfer surface. It was ounted horizontally and connected so as to maintain a epth of $8\frac{1}{4}$ in. of condensed liquid inside the shell and us allow a certain amount of subcooling of the con- ensate.

The blow gases were sampled by means of a 6-in. ipe welded into the blow tank stack and bent at right ngle so that a 12-in. length pointed directly downward side the stack at the center. Since the blow gases ormally carried a certain amount of entrained pulp hich would have plugged the condenser, a separating yclone was installed on the railing of the blow tank so nat the 6-in. sampling line led directly into it as shown Fig. 4. The vapors from the separator were led to ne condenser through a 6-in. steel pipe.

In order to remove the noncondensable gases from the ondenser and bring them to the oxidation unit, a Pen-berthy air ejector was installed. Preliminary tests showed that it would allow the removal of 13 c.f.m. of noncondensable gases with approximately 40 c.f.m. of

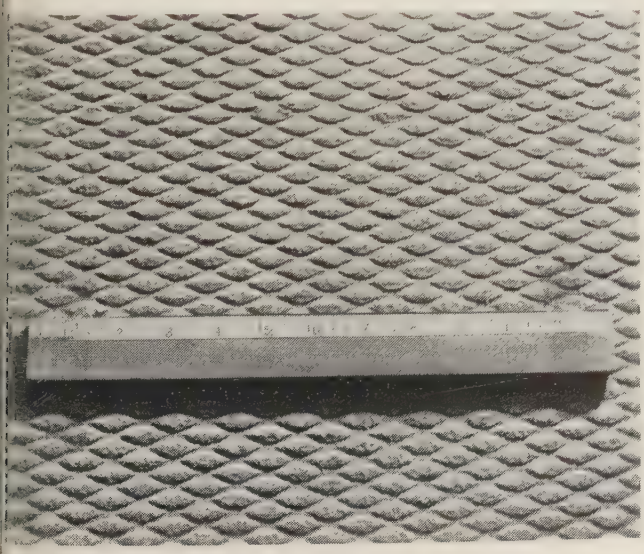

Fig. 1

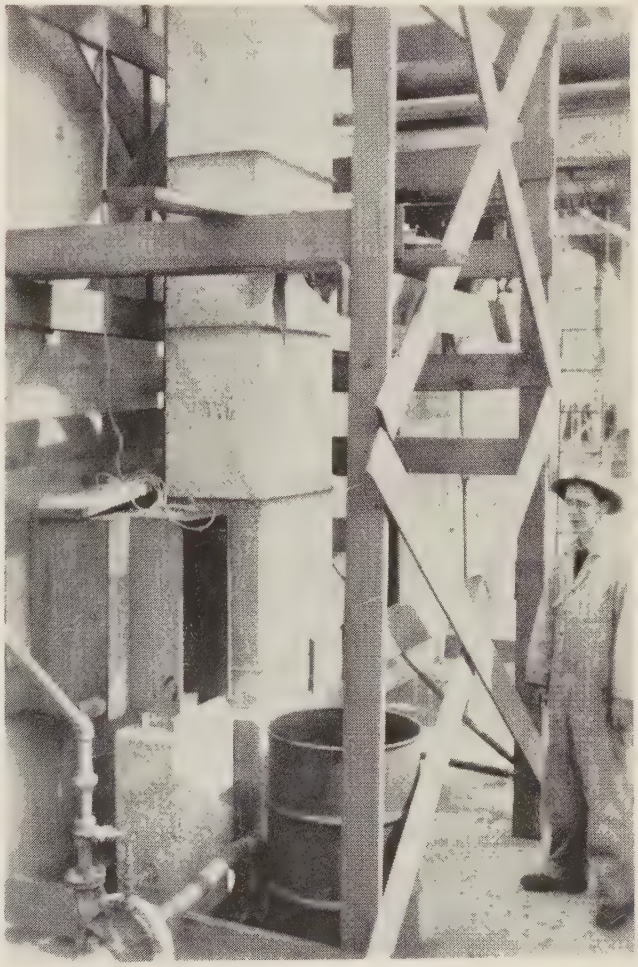

Fig. 2

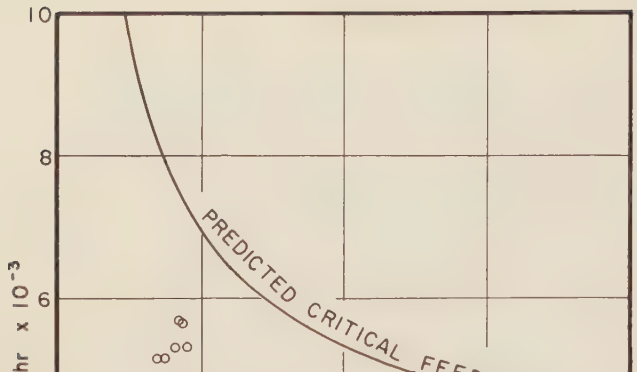

Fig. 3

compressed air giving a total of 55 c.f.m. of gas. This was close to the maximum quantity of air used in previous tests of the oxidation unit.

The condensate from the condenser was collected in steel drums and quantities were measured by meter sticks clamped to the inside of the drums. The installation is shown in Fig. 5. The instrumentation was designed to give the necessary information on temperature and flow rates so that the percentage of blow gases being condensed could be estimated and the amount of noncondensable gases being sent to the oxidation unit could be measured. In addition heat balances were made and gave results validating the calculated dirt factor of 0.0021 used in the original condenser design.

Noncondensable gases from the condenser were sampled at the outlet from the air ejector, that is, after dilution with air and at the concentration at which they entered the oxidation tower. The air issuing from the tower was sampled using a duplicate sampling kit connected by a rubber tube leading into the exhaust vent. The sampling apparatus and analytical methods have been previously described (*2*). Samples of black liquor entering and leaving the tower were taken as in the previous experiments on tower operation, that is, through a sampling cock in the black liquor feed line and as dip samples in the sump at the bottom of the oxidation unit.

In a typical run, it was estimated that approximately 220,000 lb. of water flashed off as steam when the digester was blown. The total condensate obtained in the run was 590 lb. so that the sample constituted 2.7% of the blow gases. This corresponded reasonably well with the capacity of the oxidation unit which when fed at a rate of 5350 lb. per hr. was 3.0% of the total black liquor production (at that time 180,000 lb. per hr.). The capacities of the condenser and oxidation towe were therefore reasonably well matched.

The quantity of noncondensable gas could not be ac curately measured on account of a certain amount o carry-over of condensable material from the condense into the flowrator used to meter the mixed gases. O the basis of such measurements as could be made, it wa concluded that the amount of noncondensable gas wa in the range of 7 to 10 c.f.m. in the samples studied.

EXPERIMENTAL RESULTS

The results shown in Table I show the absorption o malodorous gases in the oxidation unit.

The flow of compressed air to the ejector and of non condensable gases from the condenser together make up the total flow of gas to the tower. This varied betwee 22–54 c.f.m. at 70°F. and 1 atm. Black liquor feed rate varied between 5300 to 6100 lb. per hr. In run 13 th black liquor supply was shut off while the contaminate gases were passed through the tower. There remaine of course a significant amount of black liquor in th tower adhering to the plates which was probably re sponsible for the partial absorption of malodorous ma terial in this experiment.

The concentration of malodorous material, and es pecially of methyl mercaptan, in the noncondensabl blow gases was generally very high as was to be expecte from the results obtained previously (*3*). After mix

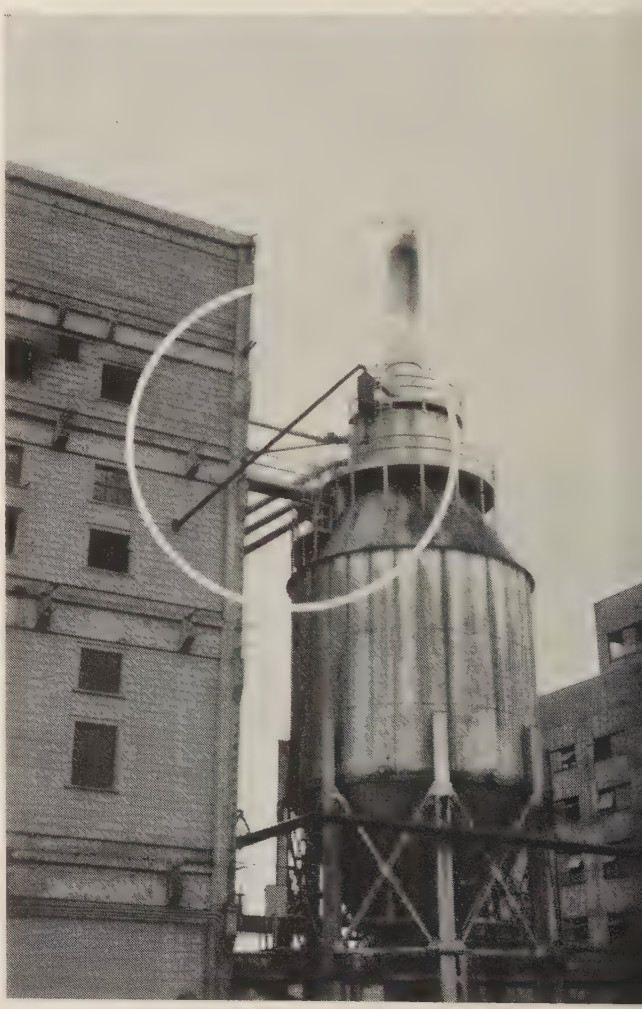

Fig. 4

with air from the ejector concentrations of methyl mercaptan up to 15,000 micrograms per liter and of hydrogen sulphide up to 300 micrograms per liter were found.

Compared with these, the amounts found in the air leaving the tower were much lower and the tests were frequently negative. Run 14, which followed immediately after the experiment with the black liquor supply shut off, suggests a certain amount of breakthrough but this may have been partially due to incomplete purging of the sampling line. Run 16, which was a repetition of run 14, gave lower but perceptible quantities which are probably more reliable, namely 48 micrograms per liter of mercaptan and 2.4 micrograms per liter of hydrogen sulphide. Taking run 16, as an unfavorable case, it is apparent that the unit absorbs at least 90% of the hydrogen sulphide and 99% of the methyl mercaptan. In run 16, the air flow was considerably reduced. In other runs where the air feed was higher, practically complete absorption was obtained.

The condensate from the condenser was a very foul smelling liquid indeed. While its odor suggested the presence of sulphate turpentine, no significant amounts of this material were seen to separate. Samples of the condensate which were brought back to the laboratory in serum bottles and analyzed after about 3 weeks were found to contain 30 to 80 mg. per liter of hydrogen sulphide and 50 to 70 mg. per liter of methyl mercaptan.

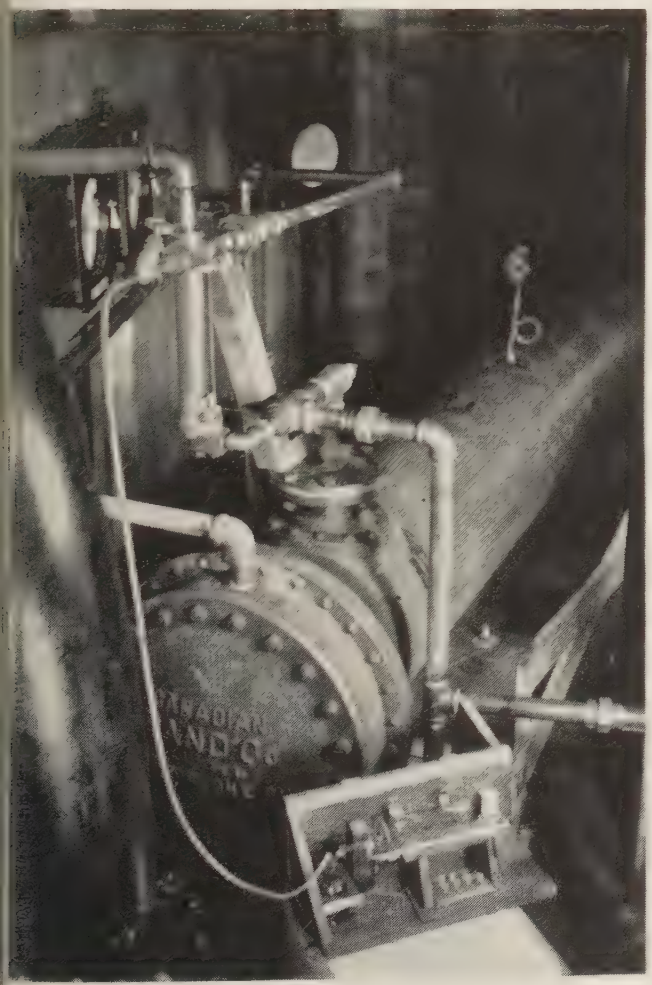

Fig. 5

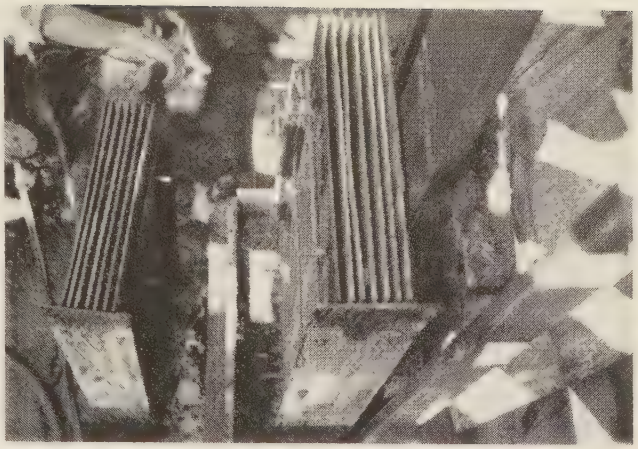

Fig. 6

The values for methyl mercaptan were lower than those obtained previously (*3*) but this may have been due to loss through oxidation or otherwise. The smell was much less unpleasant at the time the analyses were made. It is probable that the blow tank condensate would require special treatment if it were to be discharged in quantity.

Taking the total volume of noncondensable gases per blow as 6000 cu. ft. and the average mercaptan content as 40,000 micrograms per liter, the quantity of sulphur (as Na_2SO_4) recovered per blow would be approximately 44 lb. This works out at about 4 lb. per ton of pulp.

It will be seen from the analyses of the black liquor entering and leaving the tower that the oxidized black liquor still contained small amounts of sodium sulphide. This reduced efficiency was not due to the addition of the noncondensable digester gases to the air since similar results were obtained when no such addition was made. This part of the study was carried out at the end of the period of experimentation and shortly before the oxidation unit was dismantled. It was observed at this time that the unit was showing a reduced oxidizing efficiency and, when it was dismantled, it was found that several packing plates had warped out of line sufficiently to produce dripping inside the tower. This would of course readily account for a fall in efficiency since black liquor which drips through the tower is not exposed to the air long enough for oxidation to take place. The photograph shown in Fig. 6, taken during the dismantling and after removal of the topmost sections of packing plates shows the warping quite plainly.

The experimental unit described in this paper did not include any special measures for maintaining positive alignment between the upper and lower plates in adjoining sections. It would be a matter of no great difficulty to include such measures in an oxidation unit of more permanent construction.

LITERATURE CITED

1. Wright, R. H., *Tappi* 36: 85–88 (1953).
2. Wright, R. H., Schoening, M. A., and Hayward, A. M., *Tappi* 34: 289–94, (July, 1951).
3. Schoening, M. A., and Wright, R. H., *Tappi* 35: 564–569 (1952).

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The Effect of Black Liquor Fixation on the Release of Kraft Odors

R. H. WRIGHT, M. A. SCHOENING, and L. W. SHEMILT

An experiment is described in which the recovery system of a kraft mill was fed exclusively with oxidized black liquor for a period of approximately 5 hr. Analyses of the evaporator effluents and stack gases showed that the amounts of hydrogen sulphide and methyl mercaptan set free were reduced thereby. It is concluded that black liquor oxidation or fixation should be effective in reducing the area over which the odor from a kraft mill can be perceived.

THE problem of odor control in the kraft process has been a vexatious one for more than 50 years. One of the most important steps toward an effective solution was made some years ago when Bergstrom and Troebeck (*1*) showed that "black liquor oxidation" was effective in reducing the release of odor in the multiple-effect and cascade evaporators, and also, under certain conditions, the amount released in the furnace. The process had, of course, no effect on the amount of malodorous material released from the digesters. It was also reported that oxidation had other advantages including improved sulphur recovery and reduced corrosion in the recovery system.

It is well known that sulphate black liquor has a marked affinity for the oxygen of the air, particularly at elevated temperatures, and Bergstrom and Troebeck showed that a major part of the oxygen taken up is used in oxidizing the mercaptans and inorganic sulphides. The organic constituents of the black liquor appear to act as catalysts.

The term "black liquor oxidation" has been applied to this process. It is, of course, only a partial oxidation since only certain constituents of the liquor are oxidized. Complete oxidation only takes place in the recovery furnace. Tomlinson and his co-workers (*2*) have used the term "black liquor stabilization" to describe essentially the same process. Since the object of the operation is to fix volatile sulphur compounds in the liquor by oxidizing them to less volatile derivatives, the term "black liquor fixation" appears to be more accurate.

Published accounts of black liquor oxidation experiments (*1*, *5*) and installations (*2*, *3*, *4*, *6*) indicate that some measure of odor reduction may be obtained. In none of these installations was the odor effectively eliminated, because black liquor oxidation or fixation can be expected to affect only the odors arising from the recovery system, that is from the multiple-effect and cascade evaporators and from the furnace gas. Digester gases are not directly affected.

Early in 1951, an experimental black liquor fixation unit was constructed at the Bloedel, Stewart and Welch Pulp Mill at Port Alberni, B. C., which included certain special measures for the absorption of noncondensable digester gases. The construction and performance of this unit have been previously described (*7*). In an attempt to determine the probable effect of black liquor fixation on the release of odor from the recovery plant, a special experiment was carried out during July, 1951.

The semipilot oxidation unit was operated almost continuously from July 9 to July 17, 1951, and about 16,000 cu. ft. of oxidized black liquor were collected. The oxidation efficiency of the tower was lower than in previous tests but was reasonably satisfactory in that the sodium sulphide concentration of the black liquor was reduced well below 1 gram per liter. On July 18 the oxidized black liquor collected during the period of continuous tower operation was passed into the recovery system in place of the regular feed of unoxidized black liquor. The effect of this change was studied in detail.

EXPERIMENTAL PROCEDURE

In order to follow changes in the liberation of malodorous substances resulting from this sudden change over to oxidized black liquor, the various gaseous and liquid effluents from the recovery system were sampled at frequent intervals throughout the day. The absorption apparatus for gaseous effluents and the analytical procedures previously described (*8*, *9*) were used. All liquid samples were taken in serum bottles of suitable size and immediately closed by rubber serum caps.

Plans for the operation provided for the sampling to begin at 8:00 a.m. and to continue at 20-min. intervals throughout the day. As a result of various delays some stations did not begin sampling until 8:35 a.m. All were in operation before the flow of oxidized black liquor began. Samples from all stations were brought to an improvised analytical laboratory. Analyses of the solutions containing hydrogen sulphide and methyl mercaptan absorbed from noncondensable gases were completed on the day of the test to avoid loss through oxidation by dissolved oxygen. The remaining samples (except for the strong black liquor samples) were analyzed on the following day. The strong black liquor samples were brought back to the British Columbia Research Council Laboratory and there analyzed for sodium sulphide by the standard procedure (*9*) after being warmed, mixed, and diluted with water in the ratio 1 to 3.

Samples

Altogether some hundreds of analyses were carried out. The samples were collected as follows:

R. H. WRIGHT, Head, Division of Chemistry, British Columbia Research Council, M. A. SCHOENING, Assistant Chemist, British Columbia Research Council, Vancouver, Canada; Present Address: Sherritt-Gordon Mines Ltd., Ottawa, Canada; and L. W. SHEMILT, Associate Professor of Chemical Engineering, University of British Columbia.

Evaporator Noncondensable Gases. During the odor survey previously described (*8*) noncondensable gas samples could not be obtained from the barometric condenser of the multiple-effect evaporator directly, but only after being mixed with air. Arrangements were made to sample the noncondensable gases without dilution by fitting a valve in the blank flange in the top of the seal pot.

Evaporator Contaminated Condensate. The contaminated condensates from the second, third, and fourth effects of the multiple-effect evaporator are combined and pumped to the recausticizing plant. Samples were taken from the valve on the discharge side of the pump. This effluent had not been studied in the survey described previously (*8*).

Evaporator Jet-Condenser Effluent. The effluent from the jet-condenser was sampled after leaving the barometric leg of the jet-condenser.

Furnace Gases. Samples of furnace gas for Orsat analyses were formerly taken at a point near the top of the furnace. Shortly before the work herein described, the sampling line was moved to a point closer to the cascade evaporator. Samples of furnace gas were taken at this point, using a water aspirator to provide suction and the standard condenser trap assembly (*8*) to remove condensable gases.

Stack Gases. Stack gases were sampled through an opening in the top of the breeching where the gases pass from the electrostatic precipitator to the duct. The samples were collected at a depth of 12 ft. using a filter to remove dust and fly ash.

Weak Black Liquor. Weak black liquor entering the multiple-effect evaporator was sampled at the regular sampling cock on the furnace operating floor.

Strong Black Liquor. Strong black liquor was similarly sampled from the regular sampling by-pass on top of the strong black liquor storage tanks.

Course of the Experiment

Oxidized black liquor was turned on to the multiple effect evaporator at 9:05 a.m. This was 25 min. earlier than had been planned but the early start was made necessary by the low level of the liquor in the storage tank.

As far as can be ascertained no changes were made in the evaporator operation when the change-over to oxidized liquor took place. The following black liquor flows were subsequently recorded:

9:05 a.m., 325 U. S. g.p.m.
9:53 a.m., 331 U. S. g.p.m.
10:45 a.m., 345 U. S. g.p.m.
11:13 a.m., 340 U. S. g.p.m.
12:28 a.m., 343 U. S. g.p.m.

At 2:00 p.m. the flow started to drop rapidly. The level in the oxidized black liquor tank was slightly over 3 ft. After passing through a minimum of 217 U. S. g.p.m. the feed rose to a maximum at 2:08 p.m. of 376 U. S. g.p.m. and then settled at 2:10 p.m. to 343 U. S. g.p.m.

These violent fluctuations were caused by the fact that the change-over from the oxidized to the unoxidized black liquor storage tanks was delayed by a few minutes, just long enough for the level to fall too low.

At about 2:22 p.m. difficulties in evaporator operation occurred with the flow dropping off rapidly and by 2:45 p.m. the evaporator had to be shut down. The first effect (next to the cascade), and the only effect heated by direct steam, had gone so low in feed that the black liquor had started to bake on the tubes. As a consequence it had to be boiled out before being put back into service. The feed of oxidized black liquor from the evaporators thus finished about 2:26 p.m. Since it was not until after then that the steam flow to the first effect was finally cut off, it is probable that almost all the oxidized black liquor had passed through the evaporator before it was finally shut down.

At about 2:20 p.m., when the flow of strong black liquor from the evaporator was greatly reduced, the strong black liquor storage tank containing unoxidized strong black liquor was switched into the cascade. This change would not be expected to affect the progress of the oxidized liquor through the evaporator. Apart from possible oxidation of the strong black liquor during storage, the only possible difference would be a temperature effect which would be negated by the time the feed reached the furnace, and a Baumé difference which might be felt in the furnace. It is possible that the several changes were sufficient to cause somewhat erratic furnace operation. The temperature of the black liquor entering the furnace certainly showed fluctuations that were larger than usual.

The multiple-effect evaporator was shut down as described and the first effect was boiled out between 3:35 and 4:25 p.m. The evaporator was started again between 4:25 and 5:15 p.m. The following black liquor feed rates were subsequently recorded; 5:15 p.m. 358 and at 9:30 p.m. 342 U. S. g.p.m.

At 9:05 a.m. when the oxidized black liquor was fed into the evaporator, the flow of strong black liquor from the evaporator was bypassed from the strong black liquor storage tanks and fed directly into the cascade. Thus no salt cake make-up was added during the test. This was unfortunate but unavoidable if the strong black liquor was to reach the cascade without becoming diluted with unoxidized material.

The effect of the oxidized black liquor on furnace operation is difficult to estimate accurately. The low bed and high flame which were observed were primarily due to the absence of salt cake make-up during the test period and no other untoward results were noticed.

THE EFFECT OF BLACK LIQUOR FIXATION ON ODOR RELEASE

Figure 1 shows the concentration of sodium sulphide in the weak black liquor entering the multiple-effect evaporator and the concentrations of mercaptan and hydrogen sulphide in certain of the effluents from the multiple-effect evaporator.

It will be seen that the amount of hydrogen sulphide and methyl mercaptan in the contaminated condensate decreased materially following the admission of oxidized black liquor. With the noncondensable gases the decrease was somewhat delayed, perhaps because of the time required to sweep out the system.

From the standpoint of odor reduction, it is apparent that the odor arising from the multiple-effect evaporator is not large, but, such as it is, prior oxidation or fixation of the black liquor reduces it very distinctly. The analytical method used is more sensitive for hydrogen sulphide than for methyl mercaptan so that the

values for mercaptan shown in Fig. 1 are minimal and of rather low precision. Neverthless, the data indicate a definite reduction in the amounts of both hydrogen sulphide and methyl mercaptan liberated in the evaporator in the period during which it contained oxidized black liquor.

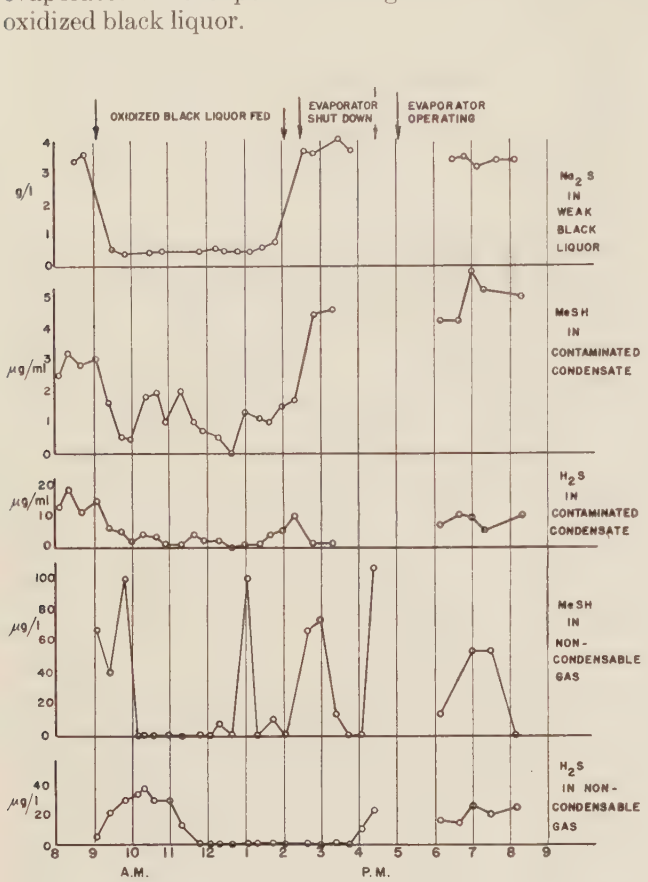

Fig. 1

The analyses of the samples of furnace gas collected at the Orsat station are shown in Fig. 2. The hydrogen sulphide and mercaptan concentration were uniformly low until shortly after 3:00 p.m. when there was a steep rise for which it is difficult to account. As a result of the evaporator difficulties described above the furnace was probably not operating smoothly at this time, and an increase in hydrogen sulphide concentration in the gases might have been expected. However, the rise should also have been registered within a few minutes at the stack gas sampling station and as can be seen from the figure this did not happen until almost 3 hrs. later. On the other hand, shortly after 3:00 p.m. difficulties were encountered in the supply of water to the condenser on the sampling line at the Orsat station and only two samples of condensable material were collected there after that time. The high values for hydrogen sulphide and methyl mercaptan in the "non-condensable fraction" may therefore have been caused by the inclusion of a certain amount of condensable material in the sample.

Under the circumstances it would be unwise to base any secure conclusions on the results obtained at the Orsat sampling station.

In contrast, the results obtained at the critically important stack-gas sampling station are very significant.

As can be seen from Fig. 2, a marked drop in the concentration of hydrogen sulphide and of methyl mercaptan took place within three quarters of an hour of the time the oxidized liquor was turned into the multiple-effect evaporator. It closely followed the fall in sodium sulphide in the strong black liquor. The low value of hydrogen sulphide and methyl mercaptan in the first two stack gas samples, taken at about 8:40 and 9:00 a.m., are difficult to account for except in terms of incomplete purging of the sampling line at the beginning of the day.

Following the fall in hydrogen sulphide and mercaptan concentration that took place before 10:00 a.m., the concentration remained low (with the exception of one sample at 2:40 p.m.) until nearly 6:00 p.m. By this time the oxidized black liquor must have been entirely cleared from the cascade. Owing to the unexpected change in operation resulting from the evaporator shutdown, no samples were taken of the strong black liquor feed from the strong liquor storage tanks, so that there is an unfortunate gap in the graph of strong liquor analyses. All that can be said, therefore, is that when the concentration of hydrogen sulphide in the stack gas rose to high values just before 6:00 p.m., the concentration of sodium sulphide in the strong black liquor had also risen to its normal high value.

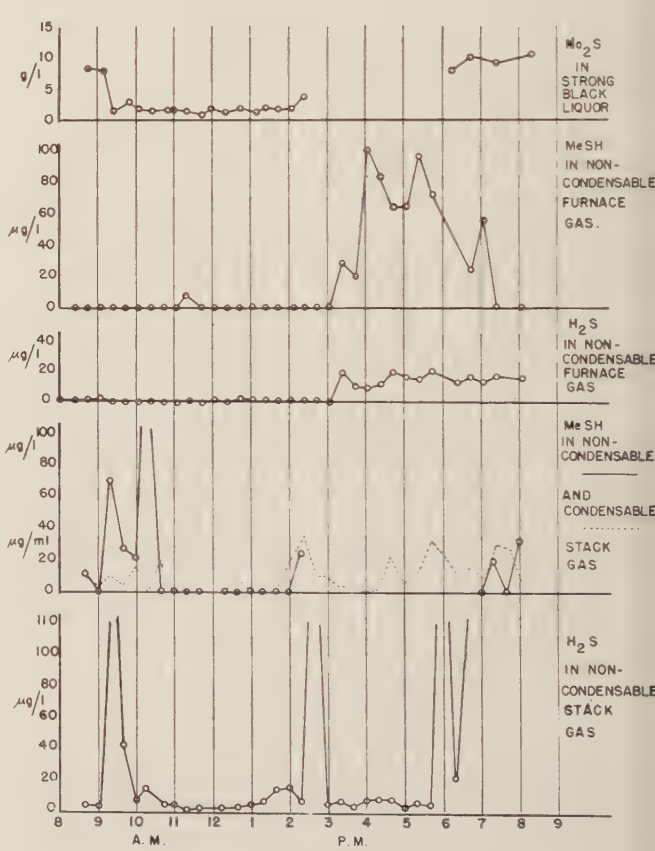

Fig. 2

Mercaptan analyses of the non-condensable stack gases between 2:30 and 6:30 p.m. were unfortunately spoiled. In Fig. 2 the mercaptan analyses of the condensate from the stack gases have been plotted as a dotted line and indicate the probable trend of the missing data.

Comparison of the results obtained during this experiment with those previously reported (*8*) shows a general agreement between the quantities of malodorous material when unoxidized liquor was passing through the system, and tends to confirm the reduction observed when oxidized black liquor was used.

GENERAL DISCUSSION

The primary purpose of this work has been the reduction and if possible, effective elimination of the odor nuisance from kraft pulping operations. Black liquor fixation has been invoked as a means of achieving this end. In general, it can be said that the results are encouraging.

When oxidized black liquor was passed into the multiple-effect evaporator, a distinct reduction in odor release was observed notwithstanding the fact that under the conditions existing the multiple-effect evaporator was not a serious source of odor.

The entry of oxidized strong black liquor into the cascade evaporator was accompanied with a corresponding drop in the amount of malodorous material in the stack gas which is by contrast one of the major sources of odor.

These conclusions are based on direct analyses of the various effluents. It must be said that the analytical procedure used was more sensitive to hydrogen sulphide than to methyl mercaptan. In order to give the mercaptan determinations a corresponding precision, the number of samples taken (amounting to several hundred) would have had to be doubled, with for example, larger gas volumes being passed through the absorbers for the mercaptan analysis. Under the conditions it was not possible to do this and therefore many of the mercaptan analyses were close to the lower limit of the procedure and relatively less precise than the determinations of hydrogen sulphide. Nevertheless they do confirm the conclusions based on the hydrogen sulphide determinations.

The value of black liquor oxidation in reducing the amount of odor released in the recovery operations is therefore supported by the data presented here.

A further consequence of black liquor fixation which is demonstrated at least qualitatively by the results is the reduction in sulphur losses, especially in the multiple-effect evaporator. The amounts of hydrogen sulphide or sodium sulphide found for example in the contaminated condensate were reduced by a factor of about 10 during the passage of oxidized liquor. No determinations of total sulphur in the condensate were made, but it was stated by plant personnel that there was less entrainment which would imply a reduction of chemical losses in the evaporator.

Since it has also been reported (*1, 2*) that black liquor oxidation tends to reduce corrosion the advantages of incorporating a fixation process into the system appear to be worth while. It must be pointed out, however, that black liquor fixation cannot be expected to minimize the odor release under all circumstances. It can only be effective in conjunction with correct furnace operation and the maintenance of proper conditions in the cascade. Given these conditions there can be little doubt that a substantial reduction in odor from the recovery system is to be looked for if an effective black liquor fixation system is installed. If the system also includes measures for the absorption of noncondensable digester gases (*7*) an effective degree of odor control should be obtained.

In this connection certain physiological factors relating to the sense of smell must be kept in mind. It has been reported (*10, 11*) that the response of the olefactory organ conforms to the Weber-Fechner law, i.e., the intensity of the sensation is proportional to the logarithm of the intensity of the stimulus. Thus a 10-fold change in the concentration of malodorous material is needed to produce a 2-fold change in the smell. Owing to the crudeness of olefactory discrimination, the concentration of an odorous material must be altered by about 30% to produce a barely perceptible difference in sensation. Since the ordinary observer is concerned with the presence or absence of an odor rather than its intensity, odor control systems are likely to be judged on an all-or-none basis.

It is unlikely that the release of malodorous material in the kraft process will ever be reduced to a point where no odor can be detected inside the plant. As one moves away from the plant the concentration of malodorous materials in the air diminishes progressively in a way that will depend on the local ground and air conditions. At a sufficient distance the concentration of malodorous material will fall below the threshold of perception. The first and indeed the only noticeable effect of an odor reduction process will be to reduce this distance. Owing to the logarithmic form of the Weber-Fechner law and the unpleasantness of the smell, the odor will be regarded with disfavor wherever it is perceptible at all.

Black liquor fixation and the absorption of digester gases, by reducing the concentration of malodorous material at the mill, may be expected to contract the area over which the odor can be perceived. Within that area it will continue to cause complaint because the ordinary observer will not note much change. The degree of success to be expected from a particular installation will therefore depend not only on the effectiveness of the odor control apparatus, but also on the local geographical and atmospheric conditions.

LITERATURE CITED

1. Bergstrom, H., and Troebeck K. G., *Svensk. Papperstidn* 42: 554–557 (1939).
2. Tomlinson, G. H., Tomlinson II, G. H., Swartz, J. N., Orloff, H. D., and Robertson, J. H., *Pulp Paper Mag. Can.* 47: 41–77 (1946).
3. Reid, H. A., *Australian Pulp & Paper Ind. Tech. Assoc. Proc.* 3: 479–500 (1949).
4. Bialkowsky, H. W., and Dehaas, G. G., *Paper Mill News* (Sept. 1, 1951).
5. Collins, Jr., T. T., *Paper Trade J.* 37–40 (Jan. 19, 1950).
6. Bergstrom, H., and Troebeck, K. G., *Canadian pat.* 481,587 and 502,880.
7. Schoening, M. A., Shemilt, L. W., and Wright, R. H., *Tappi* 36, No. 4: 176–179 (April 1953).
8. Schoening, M. A., and Wright, R. H., *Tappi* 35: 564–9, 1752.
9. Wright, R. H., Schoening, M. A., and Hayward, A. M., *Tappi* 34: 289–294 (1951).
10. McCord, C. P., and Witheridge, W. N., "Odors, Physiology and Control," page 45, McGraw-Hill, 1949.
11. Moncrieff, R. W., "The Chemical Senses," page 53, Wiley, 1944.

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The Hydrodynamic Resistance of Particles

NICHOLAS SHOUMATOFF

In this paper a more generalized method of calculating the hydrodynamic resistance of particles is attempted. Assuming continuity of relationships for massed and isolated particles, a critical re-examination is made of the basic geometric model and of the dimensional analysis. A new measure of characteristic size for particles of unspecified shape is presented. Because of the nonlinear effect of velocity, it is found that, in principle, no adequate measure of average velocity is available if the particles are in a state of agitation. On the same basis, the nonexistence of a general resistance transformation between massed and isolated particles is demonstrated if the particles are of nonuniform size. For the case of uniform particles, this general transformation is carried out. Rather than attempt to reconcile the conflicting conclusions of previous workers, the experimental verification of the present analysis is limited to a single unusually comprehensive and consistent set of data for uniform spheres (Wilhelm and Kwauk). The validity and precision of the resulting equation are demonstrated by statistical analysis. Applicability of the experimental constants to shapes other than spheres is discussed.

ALTHOUGH the aim of this paper is a generalized analysis of the resistance between particles and fluids, its results are applicable to a variety of problems in the paper industry, such as settling of lime mud in white liquor clarification, filtration, water treating, centrifuging, and dust collecting. It also may be of interest in connection with fundamental research on properties of particles such as interpretation of particle size tests by permeability methods, and freeness of pulp.

Many attempts have been made to describe the hydrodynamic behavior of massed particles by a single equation with minimum empiricism and maximum generality. In this study the same objectives are sought, but at each step of the analysis the apparently necessary limits of generality are critically examined and emphasized. At the outset it appears necessary to forego a completely analytical solution because of the severe restrictions that this involves in the geometrical model. However, a considerable reduction in the degree of empiricism is obtained from the assumption of hydrodynamic continuity between massed and isolated particles. Pursuing this hypothesis, the resistance equations are developed in commensurate terms for both massed and isolated particles, and investigation is made of the conditions under which transformation between the two can be accomplished. Experimental data are used to verify the results of this comparison and to evaluate the residual unknowns for the important class of phenomena when the particles are uniform spheres. A general form of the resistance equation is set up, applicable to both isolated and massed particles, containing four empirical constants of unequal generality. The values of these constants must be separately determined and substituted into the equation when the conditions are beyond the scope of the experimental evaluation here presented.

Dimension legend:

M—mass
L—length
T—time

Nomenclature and dimensions:

A_0—total cross-section area, L^2
a—specific surface, L^{-1}
b_i, c_i, d_i—exponents, dimensionless
D—diameter, L
F—drag, MLT^{-2}
g—gravity acceleration, LT^{-2}
K_i—coefficient, dimensionless
K_p—shape factor, dimensionless
L—length of tube of flow, L
N—number of particles, dimensionless
P—wetted perimeter, L
Δp—pressure drop, $ML^{-1}T^{-2}$
Q—flow rate L^3T^{-1}
R—hydraulic radius, L
S_p—aggregate particle surface, L^2
t—Student's "t," dimensionless
$\bar{u}$—vector average velocity, LT^{-1}
u_0—velocity of approach, LT^{-1}
V_f—void volume, L^3
V_o—total volume, L^3
V_p—aggregate particle volume, L^3
z—Fisher's "Z," dimensionless
ϵ—fraction of voids, dimensionless
μ—fluid viscosity, $ML^{-1}T^{-1} \times g$
ρ—fluid density, $ML^{-3} \times g$

STATISTICAL GEOMETRY

The geometry of massed particles is not derivative from the classical models for flow through conduits or around isolated solid bodies. The former is completely described by the dimensions occupied by the fluid, and the latter, by the dimensions of the solid. For massed particles, on the other hand, both the solid and fluid dimensions are involved.

An exact description of the geometry of particle groups, which would be necessary for a completely analytical solution of the resistance problem, is possible only for a few special cases having greatest simplicity as to shape, arrangement, or number of particles. A different type of description, in terms of averages and totals, can be used with increasing convenience and accuracy as the system becomes more complex. This approach, which has been adopted here because of its greater generality, also involves important specific restrictions:

1. The *over-all dimensions* of the system must be large so that special conditions at the boundaries need not be considered, but not so large that the properties of the fluid passing through the mass are significantly nonuniform.

2. The particles must be *large* in *number* and with *statistically homogeneous* geometric properties. (No other restriction is made, however, as to shape, size, or size distribution.)

3. All "special" or "nonrandom," that is, *systematic*

NICHOLAS SHOUMATOFF, Process Engineer, West Virginia Pulp & Paper Co., New York 17, N. Y.

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or *segregated* arrangements, which have low probability or entropy, can*not* be considered by this method without probably involving serious errors.

4. A solution based on this method lacks the character of mathematical exactness and is always an approximation whose accuracy in any actual physical problem depends on the degree with which the specified restrictions are met.

Proceeding with the analysis from these assumptions, the basic geometric model is constructed as a *tube of flow* of uniform cross section A_o and length L, the product of which is the total volume V_o, which is composed of two intimately mixed fractions, the solid volume V_p and the fluid volume V_f. The fraction of "voids," which is the basic measure of the degree of expansion of the system, is defined as

$$\epsilon = \frac{V_f}{V_o} \tag{1}$$

All expansion is conceived to occur in the general direction of flow, so that with A_o and V_p remaining constant, the variable length

$$L = \frac{V_p}{A_o(1 - \epsilon)} \tag{2}$$

Although the actual velocity of the fluid varies both in magnitude and direction from point to point, the *vector average* velocity $\bar{u}$ is the same for all cross sections, and is inversely proportional to ϵ for any given rate of flow Q. A more convenient, although fictitious, measure of velocity is

$$u_o = \frac{Q}{A_o} = \bar{u}\epsilon \tag{3}$$

The important advantages of u_o are that (1) it is independent of ϵ, and (2) it can be measured directly at the entrance or exit of the system. The entire system may be in uniform motion in which case the velocity is measured relative to the particles. However, the particles must be *at rest with respect to each other*. Consider an extreme case in which half of the particles have same velocity as the fluid, and the other half moves at same speed in opposite direction. Assume turbulent flow with resistance proportional to square of velocity; then the resistance would be just twice as great as when all the particles are at rest. Thus no adequate measure of velocity is available with respect to a system of circulating or agitated particles, since the resistance is affected by the degree of agitation. For isolated particles, u_o is *identical* with the true velocity.

The open cross section is highly irregular regardless of particle shape. Therefore, the hydraulic radius is the only available linear dimension (by its very nature a statistical average) which can be expected to characterize the *mass* of particles hydrodynamically with any degree of accuracy. To evaluate the hydraulic radius requires knowledge of the average "wetted perimeter," which cannot be measured directly, and which is dependent on ϵ. However, the average hydraulic radius can be calculated from two constant geometric properties of the particles as follows:

$$R_H = \frac{\epsilon}{K_p a(1 - \epsilon)} \tag{4}$$

where

$$K_p \equiv \frac{1}{S_p}\int_0^L PdL \tag{5}$$

and

$$a \equiv \frac{S_p}{V_p} \tag{6}$$

This expression for the hydraulic radius is familiar with the exception that the shape factor K_p was not previously included. In earlier studies it was assumed that the straight line integral of the perimeter equals the total surface, which is not the case. For spheres, for example, $K_p = \pi/4$, while for other shapes it varies with orientation but apparently is always less than unity. It should also be pointed out that from the above definition, the quantity a is the ratio of total surface to total solid volume, which in general is *not* equal to the arithmetic mean specific surface. This means that for mixed sizes of similar particles, the "average particle size" which must be used in calculating the hydraulic radius is the ratio of the sum of the cubes to the sum of the squares of the linear dimensions of the individual particles (*1*). If the particles are of irregular shape, a photograph of a representative sample of the particles can be used to calculate a from the approximate expression $3P/2A$, and K_p by a process of graphic integration (*2*).

From the expression for the hydraulic radius it is seen that $1/K_p a$ is the characteristic linear dimension of the particles themselves, independently of the degree of expansion. It is, therefore, preferable to establish this independent quantity as one of the basic variables in the problem in the same way as was done with the measure of velocity. This is further necessitated by the fact that a discontinuity occurs in the hydraulic radius as the particles become isolated so that it would be impossible to test the hypothesis of hydrodynamic continuity between massed and isolated particles by the use of the hydraulic radius as such. On the basis of this hypothesis it is assumed that $1/K_p a$ is the proper linear characteristic of isolated as well as massed particles. This does not imply that it can be used interchangeably for differently shaped particles in a resistance equation without affecting the value of the empirical constants. It must be remembered that $1/K_p a$ is merely a statistical ratio which cannot be expected to account completely for the hydrodynamic differences which can be demonstrated by exact mathematical analysis between different shapes of solid bodies. On the other hand, because of its definitive role in the hydraulic radius, it is probably the best common denominator, which will probably yield empirical correlations of maximum generality and simplicity.

Factoring out $1/K_p a$ from the hydraulic radius leaves only the two dimensionless ratios ϵ and (1- ϵ). Since these two functions of the degree of expansion are virtually independent of each other as either approaches unity, both should be considered among the possible independent variables affecting the resistance.

If F designates the resistance drag of any individual particle, then the total drag of a mass of particles can be calculated from the over-all pressure drop as follows:

$$\Sigma F = A_o \Delta p \tag{7}$$

The pressure gradient, measured as Δ_p/L, is assumed

to be statistically uniform although the error involved in this assumption obviously increases as the mass of particles is expanded. Therefore, the resistance of highly expanded masses of particles must be studied in terms of drag rather than pressure. In other words, for isolated particles, the geometric model for the massed particles breaks down, and it is necessary to deal with them as discrete individuals. The concept of resistance force, however, provides the basis for establishing the hydrodynamic continuity between the two states.

DIMENSIONAL ANALYSIS

In the preceding section, four basic independent variables affecting the resistance of massed particles were defined: u_o, $K_p a$, ϵ, $(1 - \epsilon)$. The statement of the dynamic problem is completed by introducing the fluid viscosity μ and density ρ. Only four of these six variables are required to define the resistance of isolated particles, since ϵ and $(1 - \epsilon)$ are not relevant. The resistance, considered as the dependent variable, is measured as $\Delta\, p/L$ for massed particles and as F for isolated particles. Considering these two problems separately, the general forms of the two resistance equations are derived by dimensional analysis:

$$\frac{\Delta p}{L} = \frac{\rho u_o^2 K_p a}{g} \sum_{i=1}^{n} K_i \left(\frac{\mu K_p a}{\rho u_o}\right)^{b_i} \epsilon^{c_i} (1 - \epsilon)^{d_i} \qquad (8)$$

$$F = \frac{\rho u_o^2}{g(K_p a)^2} \sum_{i=1}^{n} K_i' \left(\frac{\mu K_p a}{\rho u_o}\right)^{b_i'} \qquad (9)$$

The first of these equations is converted to units of force by substitution of equations (2), (6), and (7):

$$\Sigma F = \frac{\rho u_o^2 K_p S_p}{g} \sum_{i=1}^{n} K_i \left(\frac{\mu K_p a}{\rho u_o}\right)^{b_i} \epsilon^{c_i} (1-\epsilon)^{d_i - 1} \qquad (10)$$

When $\epsilon = 1$, the last two equations are comparable, from which it is immediately evident that $(d_i - 1) = 0$. This result is of major importance since it eliminates $(1 - \epsilon)$ as a separate independent variable.

The summation on the right-hand side of equation (10) is thus reduced to a polynomial in two dimensionless quantities—first, the Reynolds number referred to the characteristic particle size, and second, the fraction of voids. Since ϵ is independent of all the variables in the Reynolds number, it must be independent of the Reynolds number itself. However, if both of these dimensionless quantities had different exponents in the different terms of the polynomial, the effect of either would be dependent on the magnitude of the other. This suggests that the function of either one or the other must be factorable from the polynomial. If the Reynolds number function were thus factorable, the sum of the coefficients of the remaining polynomial in ϵ would have to be equal to one for comparison with equation (9). This would be a most unlikely situation since the coefficients are arbitrary empirical constants. Therefore, it appears necessary to assume that the function of the fraction of voids is factorable, so that it may be expressed as a single exponential ϵ^c. The function is thus reduced to a form which is very convenient for experimental evaluation.

Although in the preceding section it was specified that the mass of particles must be large, the form of equation (10) is such that it applies (with less accuracy) to any part of this large mass. Specifically, according to one of the laws of statistics, the error is inversely proportional to the square root of the number of particles being considered, provided that they are selected in a random manner. This is true even if *only one* particle is selected. However, in all of these possible cases, the equation states the most probable or *expected value* of the drag. The error is considerably reduced, of course, if the values of the geometric characteristics are calculated separately for each individual sample, rather than use the values from the mass as a whole. Thus, it is possible to make a direct comparison between equations (9) and (10) for an arbitrary individual particle. When the factor ϵ^c is removed from equation (10) at the value $\epsilon = 1$, the remaining expression is exactly equivalent and correspondent to equation (9). There is no reason to expect the destruction of this correspondence when the value of ϵ is reduced, since all of the other variables are independent of ϵ. Therefore, it must follow that the factor ϵ^c can be introduced into equation (9) as well as (10). The two equations can now be rewritten in a single combined form, for N particles:

$$\sum_{j=1}^{N} F = \sum_{j=1}^{N} \left[\frac{\rho u_o^2}{g(K_p a)_j^2} \sum_{i=1}^{n} K_i' \left(\frac{\mu K_p a}{\rho u_o}\right)_j^{b_i'} \epsilon^c\right] = \frac{\rho u_o^2 K_p S_p}{g} \sum_{i=1}^{n} K_i \left(\frac{\mu K_p a}{\rho u_o}\right)^{b_i} \epsilon^c \qquad (11)$$

Since no restriction has been made as to the size distribution of the particles, inspection of this equation shows that the different terms in the polynomial friction factor will have different *relative* magnitudes for each different particle size. Some of the particles may be in the "viscous flow" range and others in the "turbulent flow" range depending on the magnitudes of their individual Reynolds numbers. Therefore, it is evident that *no general transformation is possible* between the individual coefficients and exponents in the polynomial for the massed particles as compared with the corresponding constants for the individual particles. This does not imply that the relationship between the two sets of values is indeterminate, but it means that in the general case equation (11) cannot be simplified. Any specific empirical transformations that might be discovered for nonuniform particles can be expected to apply accurately only to a narrow set of experimental conditions. Of the two sets of constants, those applying to individual particles can obviously be expected to have much greater generality since they are independent of the size distribution except in extremely small sizes where molecular phenomena come into play. It can, therefore, be stated that accurate and broadly applicable friction factor constants for massed particles of mixed sizes probably do not exist, and also that there is no method of expressing the effective average size of mixed particles which could be used interchangeably with the characteristic size of uniform particles independently of the flow conditions.

For the special case of N particles all having the same characteristic size and, therefore, the same expected value of the drag, equation (11) can be divided by N and the comparison between the two expressions for the drag can be completed with the following definite and completely general results:

$$b_i = b_i'; \qquad K_i = K_i' \left(\frac{N}{K_p{}^3 S_p a^2}\right) \qquad (12)$$

These results make possible complete transformation between the equations for individual and massed particles of uniform size when the friction factor for either case is known.

EXPERIMENTAL VERIFICATION

To establish the validity of the preceding theoretical analysis, the specific point to be tested is the transformation between individual and massed particles as expressed in equation (11). However, the test will be restricted to the transformation for uniform particles, equation (12). It is clear from the previous discussion that to test the transformation for mixed sizes would be not only difficult but of doubtful practical value, since the empirical constants do not remain fixed over a broad range of flow conditions. With uniform sizes, on the other hand, a relatively simple and comprehensive verification is possible, covering a broad range of Reynolds numbers, particle size, and fractions of voids, from the normal values for fixed beds up to and including completely isolated particles. Also, in the interest of experimental precision as well as simplicity, the data are limited to spherical shapes. The experimental conditions must further conform to other limitations previously stated. In spite of these restrictions the results are applicable to a broad range of practical phenomena.

These experimental desiderata are well supplied by the data previously published by Wilhelm and Kwauk (*3*), where controlled expansion of massed particles was accomplished by balancing their weight against rising streams of *water*. (Using air, the degree of expansion could not be controlled.) Consistent data for isolated particles, obtained by free fall, are also included. These data are used as the basis of the present investigation.

The friction factors derived from the free fall data, as given in Table I, were plotted against Reynolds number on logarithmic coordinates. The plot showed pronounced negative curvature, indicating that more than one term is involved.

The first term of the friction factor is determined from Stokes' Law for viscous drag of isolated spheres:

$$F = 3\pi\mu D u_0/g \qquad (13)$$

Substituting this value into equation (9) it is found that $K_1' = 9\pi^2/2$ and $b_1 = 1$. This term was then subtracted from the observed friction factors, and the residuals were entered on the Reynolds number plot. An excellent straight line was obtained, showing that only one additional term is required. Drawing the line by eye yielded $K_2' = 18.4$, $b_2 = 0.227$. Corresponding parameters calculated from the logarithmic values by the method of linear regression (*4*) were $K_2' = 18.7$, $b_2 = 0.234$. Actually the graphic results yielded lower total deviations, and are used in the subsequent steps of the analysis.

Table I. Friction Factor Evaluation

Run no.	$\frac{\rho u_o}{\mu K_p a}$	Friction factor, Observed	Friction factor, Calculated	Deviation, %
55	2.33	33.0	33.7	−2.1
1	4.46	23.2	23.0	0.9
17	7.42	18.3	17.7	3.4
3	9.65	15.5	15.6	−0.6
15	25.9	12.4	10.5	18.1
7	134.8	5.89	6.38	−7.7
14	135.1	5.72	6.37	−10.2
8	214	5.62	5.63	−0.2
9	463	4.59	4.67	−1.7

Using this binomial friction factor with equations (11) and (12), observed values of ϵ^c were calculated for three complete runs covering the widest range of conditions, as listed in Table II. These values, plotted against ϵ on logarithmic coordinates, appeared to follow a single straight line passing through $\epsilon^c = 1$ at $\epsilon = 1$. The slope of the line drawn by eye is approximately $c = -4.4$. Again using the method of linear regression with the logarithmic values, the best straight line is calculated with slope $c = -4.21$ and intercept $\ln \epsilon^c = 0.124$ or $\epsilon^c = 1.134$ at $\epsilon = 1$. This is a discrepancy of 13.4% from the value predicted theoretically. The significance of this result is judged by comparison with the 95% confidence limit for the experimental error of the regression line at this point, which is $\epsilon^c = 1.142$ as calculated from the regression formula and the table of Student's "*t*" published by R. A. Fisher (*4*). Thus the observed deviation is not statistically significant and does not violate the basic hypothesis. However, the comparison is so close as to place some doubt on this conclusion.

A more critical and more comprehensive verification is obtained by investigating the independence of ϵ^c from the Reynolds number. This is indicated by inspection of Table II in which there does not appear to be any systematic variation of ϵ^c in the region of constant ϵ and variable Reynolds number. A quantitative test over the entire range of the data is obtained by the method of analysis of variance (*4*). The observed values of *c* for each individual point are listed in a rectangular tabulation as shown in Table III. These values were calculated by deducting the quantity 0.124 from the logarithms of the values of ϵ^c marked with an *a* in Table II, and dividing the difference by the corresponding logarithm of ϵ. Thus the values of *c* are referred to the regression intercept instead of the origin, to avoid introducing extraneous variation due to the fact that these two points do not coincide. The values in Table III, listed in corresponding order with Table II, were chosen to obtain a complete rectangular tabulation with approximately equal values of ϵ in each horizontal row, and with the maximum available number of residual degrees of freedom to obtain a valid estimate of experimental error. The variation between the means of the vertical columns is thus a measure of the influence of Reynolds number only. The variation in the vertical direction, between the means of the horizontal rows, reflects simultaneous variation of both Reynolds number and fraction of voids. The squared deviations from the general mean, due to these sources, are listed in Table IV and compared with the unaccounted-for residual, which serves as the basis for the estimate of experimental error. Using Fisher's *z*-test and the conventional 95% confidence limits, it is found that neither the horizontal nor the vertical variation in Table III differs significantly from the experimental error. As a further check, it is seen that only one of the 24 individual values in Table III lies outside its 95% confidence limits of $c = -3.38$ to -5.23 (by Student's *t*-test), so that the entire table may be considered statistically homogeneous.

Table II. Values of ϵ^c

Run no. 1			Run no. 8			Run no. 9		
$\frac{\rho u_o}{\mu K_p a}$	ϵ	ϵ^c	$\frac{\rho u_o}{\mu K_p a}$	ϵ	ϵ^c	$\frac{\rho u_o}{\mu K_p a}$	ϵ	ϵ^c
0.111	0.407[a]	74	6.66	0.368	67.3	22.5	0.385	61.4
0.144	0.439[a]	53.7	14.8	0.368	60.5	29.3	0.385	60.6
0.233	0.454[a]	24	18.8	0.368[a]	60.5	33.8	0.385	61.6
0.370	0.474[a]	19.9	20.8	0.391[a]	51.3	38.4	0.385[a]	61.0
0.733	0.581[a]	9.45	25.1	0.425[a]	38.0	46.8	0.421[a]	45.3
1.275	0.679[a]	5.05	33.4	0.480[a]	22.5	54.0	0.446[a]	36.5
2.29	0.826[a]	2.30	46.7	0.558[a]	13.9	67.1	0.484[a]	26.3
3.31	0.934[a]	1.41	73.9	0.684[a]	6.37	91.0	0.561[a]	16.2
4.46	1.000	1.0	105.1	0.794[a]	3.51	132	0.652[a]	8.5
			152	0.893[a]	1.90	194	0.763[a]	4.6
			214	1.000	1.01	280	0.856	2.44
						337	0.904[a]	1.82
						458	0.965	1.02
						463	1.000	0.98

These results, which were predicted by the theoretical analysis, are strong substantiation of this theory. The power of this verification can be appreciated when it is considered that Table III represents variation of ϵ from 0.368 to 0.934, and of Reynolds number from 0.111 to 337. With this corroborative evidence there should be no longer any reason to doubt that the discrepancy in the intercept of the regression line represents anything other than experimental error. In short, the principle of hydrodynamic continuity between massed and isolated particles may be considered to be definitely established, with the following additional specific results within the limits of this experimental verification:

1. The invariance of the Reynolds number function with respect to degree of expansion.
2. The accuracy of the Reynolds number function as evaluated.
3. The validity of the transformation equations (11) and (12).
4. The adequacy of a linear correlation between ϵ^c and ϵ.
5. The accuracy of the original data and calculations.

The best value of c to use in equation (11) is probably $c = -4.3$ which is the average of the one graphical and two numerical determinations. Based on the 24 values in Table III, the 95% confidence limits are 0.19 in either direction, a possible error of 4%. Thus the second significant figure of c is not definitely established.

PRACTICAL APPLICATION

It is convenient to summarize the results obtained into a single equation of maximum practical value:

$$F = \frac{\rho u_o^2}{g(K_p a)^2 \epsilon^{4.3}} \left[44 \frac{\mu K_p a}{\rho u_o} + 18 \left(\frac{\mu K_p a}{\rho u_o} \right)^{0.23} \right] \quad (14)$$

This equation, multiplied by N/A_o, gives the pressure drop through a mass of uniform particles. The equation states directly the resistance drag of any individual particle, whether it be isolated or in a mass, and regardless of the size distribution of other particles in the mass.

Of the five arbitrary constants, only four are empirical since the exponent of the first friction factor term, representing viscous drag only, is of theoretical origin and universal application. Possible values for the exponent of the second term, which represents inertia forces, are undoubtedly confined within close limits, with ideal minimum value of zero. Reynolds reported an equivalent value of 0.277 for turbulent flow in pipes. Such close correspondence between such widely different geometric systems suggests that the value of this exponent is probably not significantly affected by differences in particle shape, although as with pipes its value is probably closer to zero when rough surfaces are involved.

The values of the two coefficients are affected by particle shape, but not both in the same way (*5*). Separate evaluations will be required to determine whether the new characteristic size $1/K_p a$ will yield greater accuracy than earlier correlations.

Since it has been indicated that the exponent of the fraction of voids is not affected by degree of expansion or size distribution, it is difficult to see how it would be affected by the relatively less significant geometric variable of particle shape. Brownell and Katz (*6*) reported values for spheres, cylinders, and granules ranging from -3.18 to -4.44 with apparently no systematic variations (discrepancies in their values for other shapes probably due to oversight of the factor K_p as well as other differences from the method here presented).

Great care is required in the application of equation (14) in connection with possible violations of its stated limitations. Especially when gaseous fluids are involved, variability of the fluid properties and the thermodynamics of the process must be considered. Also the inherent statistical errors, indicated above, must be borne in mind.

Table III. Values of c

	Run 1	Run 8	Run 9	Av.
	4.65	3.99	4.17	4.27
	4.67	4.06	4.26	4.33
	3.87	4.42	4.31	4.20
	3.84	4.09	4.43	4.12
	4.24	4.31	4.60	4.38
	3.85	4.55	4.94	4.45
	3.71	4.92	5.20	4.61
	3.19	4.55	4.58	4.11
Av.	4.00	4.36	4.56	4.31

Table IV. Analysis of Variance

Source	Sum of squares	Degrees of freedom	Standard deviation	Values of Z	
				Observed	95% Limit
Rows	0.6258	7	0.299	−0.392	−0.636
Cols.	1.2192	2	0.781	0.568	06.79
Error	2.7416	14	0.443		
Total	4.5866	23	0.447		

LITERATURE CITED

1. Hatch, T., *J. Franklin Inst.*, p. 27 (Jan., 1933).
2. Shoumatoff, N., "Mechanics of Fluidized Carbon Particles," Thesis for the Degree of Master of Mechanical Engineering, Polytechnic Institute of Brooklyn (May, 1949).
3. Wilhelm, R. H., and Kwauk, M., *Chem. Eng. Progress* 44, No. 3: 201 (March, 1948).
4. Fisher, R. A., "Statistical Methods for Research Workers," London, Oliver & Boyd, 1940.
5. Pettyjohn, E. S., and Christiansen, E. B., *Chem. Eng. Progress* 44, No. 2: 157 (Feb., 1948).
6. Brownell, L. E., and Katz, D. L., *Chem. Eng. Progress* 43, No. 10: 537 (Oct., 1947).

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The Effects of Pressing Temperature and Heat Treatments on the Relationships Between Head Speed, Span, and Modulus of Rupture of Hardboard

HUGH WILCOX

An investigation was made of the effects of several head speeds and spans on the modulus of rupture values of three classes of hardboard: (1) untempered commercial hardboards, (2) the same hardboards after undergoing various degrees of heat treatment in an oven, and (3) experimentally produced hardboards pressed at various platen temperatures. The smallest variations in modulus values in each case occurred at head speeds of about 4 in. per min. Hardboards that were heat treated in an oven for 35 hr. at 284°F. showed that increased head speeds resulted in increased modulus of rupture values when tested on short spans. Hardboards that were manufactured at temperatures of 400°F. and above gave decreased modulus values with increased head speeds. Results of these tests indicate that a span of at least 6 in. should be used when testing 1/8-in. hardboard, and at least 10 or 12 in. for 1/4-in. board.

In a previous paper (*5*), the author discussed various methods of evaluating hardboards and presented data showing the interrelationships between head speed and span, and their effects on the modulus of rupture values of experimentally produced hardboards. Suggestions were made for a choice of head speed and span that would insure more reliable comparisons between the modulus of rupture values in the results of different workers.

In the experiments described in the present paper, similar tests were made on commercial hardboards and, in addition, a study was made of the effects of heat-tempering on the interrelationships between head speed, span, and modulus of rupture values.

EXPERIMENTAL

Ten 4 by 4-ft. sheets each of commercial 1/8 and 1/4-in. hardboard were obtained for these experiments. One 24 by 24-in. piece from each board was marked and tested according to the procedures described in the previous paper (*5*). A second 24-in. piece from each board was heat-tempered in a forced-convection oven at 284°F. for 35 hr., then sampled and tested in the same manner.

Additional tests were made on experimentally produced hardboard pressed at various platen temperatures. Nominal 1/8-in. hardboard was prepared according to the procedures described earlier (*5*) from Douglas-fir fiber produced in a Bauer pulper. Ten 12 by 12-in. boards were pressed at each of the following temperatures: 340, 400, and 460°F. For each temperature, a three-cycle pressing schedule was selected which would give a uniform specific gravity for all boards. The three pressing schedules were (1) at 340°F., pressure of 500 p.s.i. applied for 1 min., then released for a breathing cycle of 2 min., and a final drying period of 10 min. at 200 p.s.i.; (2) at 400°F., initial pressure of 500 p.s.i. for 1 min., a 1-min. breathing period, and a 10-min. final pressing at 200 p.s.i.; (3) at 460°F., initial pressure of 500 p.s.i. for 2 min., a 2-min. breathing period, and a 7-min. final pressing at 200 p.s.i.

The edge of the mat toward the front of the hot press during the pressing operation was designated as the front edge of the board. Three 2-in. strips were laid out normal to the front edge of each board, the strips being 1 in. apart, with the outer strips 2 in. from the sides of the board. The strips were divided in half by lines parallel to the front edge of the board, giving six 2 by 6-in. test pieces from each 12 by 12-in. board. Each of these six sample pieces was marked for testing at a different head speed: 0.06, 0.6, 1.0, 2.0, 4.0, and 6.0 in. per min.

The test pieces were sawed free and conditioned at 75°F. and 68% relative humidity for 2 weeks prior to testing. Flexural tests were then performed on a 2-in. span at the designated head speeds.

After the flexural tests were completed, 1 by 2-in. specific gravity coupons were cut from each specimen, as close to the break as possible. The specific gravity for the 180 samples ranged from 0.90 to 0.94, calculated on volume at test and oven-dry weight. The modulus of rupture for each test was adjusted to the average specific gravity of 0.92 on the assumption that

Hugh Wilcox, Wood Technologist (present address, State University of New York, College of Forestry, Syracuse, N. Y.), Oregon Forest Products Laboratory, Corvallis, Ore.

the modulus of rupture is directly related to the square of the specific gravity (*4*). The ten adjusted modulus of rupture values for each particular head speed were averaged to give average values for each series of boards, and the data were plotted to compare the effect of head speed upon modulus of rupture at each of the three pressing temperatures.

Collateral experiments were performed to test the extent to which variations in equilibrium moisture content influence the modulus of rupture values Five 2 by 8-in. modulus strips were cut from the remnants of each of the ten commercial $^1/_8$-in. hardboards used in the oven-tempering experiments. These strips were dried in an oven for 3 hr. at 105°C., conditions adequate to obtain a constant base weight without causing heat tempering. The samples were divided into five groups, each group containing one sample from each of the ten original hardboards. One group was tested oven-dry, and each of the remaining groups was conditioned under a different humidity condition to give a different equilibrium moisture content. The samples were conditioned for two weeks, then tested on a 6-in. span at a head speed of 4 in. per min. An average modulus of rupture was computed for each of the five equilibrium moisture content groups, and the results plotted for comparison (Fig. 6). After the tests were completed, specific gravity determinations were made on a 1 by 3-in. coupon from each strip, cut as close to the break as possible. Average specific gravity was also computed for each of the five equilibrium moisture content groups, and the results plotted in Fig. 7.

RESULTS

Figure 1, taken from an earlier article (*5*), shows the relationships between modulus of rupture and head

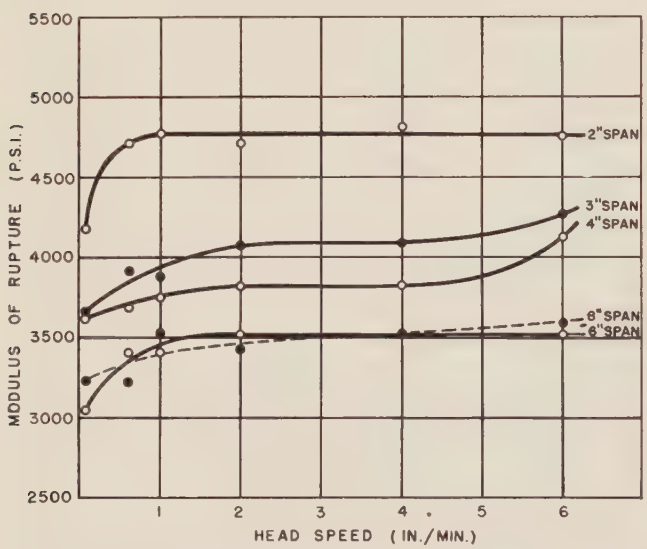


Fig. 1. Relationships between modulus of rupture, head speed, and span for a series of experimental hardboards made from salvage old-growth Douglas fir. Average thickness of boards is 0.152 in. Boards were hot-pressed at 360°F.

speed on different spans for a series of experimental hardboards made from salvage old-growth Douglas fir.

Figure 2 shows the relationships between modulus of rupture and head speed on several spans for a series of $^1/_4$-in. commercial hardboards. Figure 3 shows the same relationships for a series of $^1/_8$-in. commercial hardboards.

The results for the longer spans are quite similar in all three figures; the curves for the shorter spans are quite different from one another. Whereas the modu-

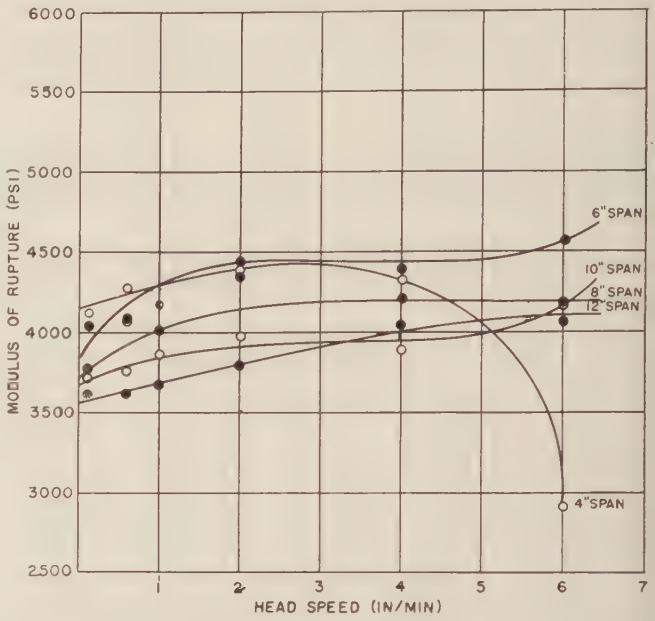


Fig. 2. Relationships between modulus of rupture, head speed, and span for $^1/_4$-in. thick commercial hardboards (made in the Pacific Northwest predominantly from Douglas-fir fiber)

lus value of the experimental board in Fig. 1 remains constant on a 2-in. span between head speeds of 4 and 6 in. per min., the values drop precipitously between these head speeds for both the 2-in. span of the $^1/_8$-in. commercial board (Fig. 3) and the 4-in. span of the $^1/_4$-in. commercial board (Fig. 2). Furthermore, the commercial $^1/_8$-in. hardboard shows a slight decrease in modulus values for 3 and 4-in. spans at head speeds between 4 and 6 in. per min., while the experimental hardboard shows a slight increase for the same conditions.

Figure 4 shows the relationships between modulus of rupture and head speed on 3 and 6-in. spans for the $^1/_8$-in. commercial hardboard, both before and after heat tempering in an oven for 35 hr. at 284°F. The solid lines represent untempered hardboards, and the broken lines heat-tempered boards, tested under the same conditions. The results show that the heat-tempered board resembles the experimental board of Fig. 1 in that the modulus of rupture for each span increases as the head speed increases from 4 to 6 in. per min.

Figure 5 shows the results of the investigations made with the $^1/_8$-in. experimentally produced hardboards pressed at various platen temperatures. All flexural tests were made on a 2-in. span in hopes of discovering an explanation for the anomalous relationships between modulus of rupture and head speed occurring for the short spans in Fig. 1, 2, 3, and 4. The results run contrary to expectation, after viewing the oven-tempering experiments in Fig. 4; instead of an increase in modulus of rupture with increasing head speed for higher temperature boards, there is a sharp drop. The higher the

temperature at which the board was pressed, the sharper is the drop.

Figures 6 and 7 show the effects of controlled moisture content on modulus of rupture and specific gravity, respectively. The change in properties does not be-

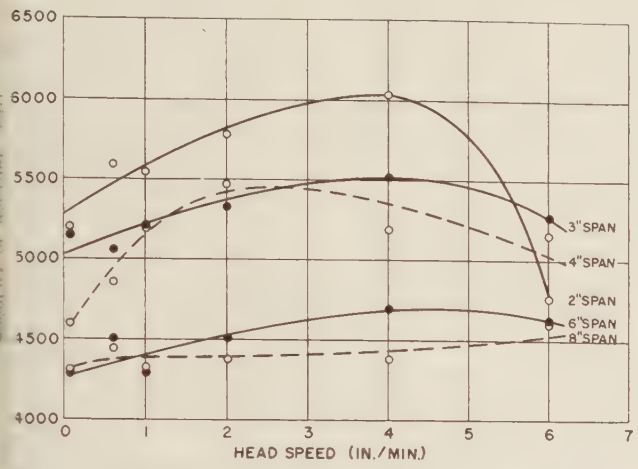


Fig. 3. Relationships between modulus of rupture, head speed, and span for 1/8-in. thick commercial hardboards (made in the Pacific Northwest predominantly from Douglas-fir fiber)

come appreciable until the moisture content is more than 10%. The 6 1/2% equilibrium moisture content is obtained by conditioning at 75°F. and 68% relative humidity, conditions which give an equilibrium moisture content of 12% in seasoning lumber products. It is necessary to condition the hardboards at over 90% relative humidity to reach a moisture content above 10%. The conditioned moisture content of hardboard is lower than the equilibrium moisture content attained by wood because the heat treatment given the fiber during the production of hardboard has destroyed some of its hygroscopicity. Thus, different hardboards may attain different moisture contents under the same humidity conditions, depending upon temperature conditions during production.

DISCUSSION

The information about the effects of heat-tempering operations revealed by this study is almost as interesting as that concerning the effects of head speed and span on modulus of rupture values. A prior consideration of these tempering effects should prove of value in interpreting the later discussion of the bending tests.

It is interesting to note that, although either heat tempering for 35 hr. in an oven at 284°F. or hot pressing at 460°F. increased modulus of rupture values, the two treatments yielded boards that behave very differently when tested on short spans at high head speeds. Although the results show that it is unwise to test hardboard under such conditions, the results will be discussed for their theoretical interest.

For the oven-tempered board tested on a short span, the modulus of rupture values increased with increased head speeds up to 6 in. per min., whereas the modulus of rupture values for the board pressed at 460°F. decreased sharply with increased head speeds from 2 to 6 in. per min. Thus, when tested on a 2-in. span at 2 in. per min., the 1/8-in. hardboard manufactured at 460°F. appeared considerably stronger than the board manufactured at lower temperature and heat tempered in an oven; but, when tested on the 2-in. span at 6 in. per min., the relative strengths appeared reversed.

Another interesting difference between the effects of oven heat treatment and platen-press heat treatment is revealed by a study of the various curves. The curves of Fig. 3 indicate that the hardboard which they represent was manufactured at a higher temperature than the 5/16-in. experimental hardboard represented in Fig. 1 (pressed at 340°F.) Nevertheless, Fig. 4 shows that prolonged heat treatment at 284°F. reversed the slopes of the modulus of rupture-head speed curves and rendered them more nearly equivalent to the comparable curves in Fig. 1. It might be expected that the heat treatment would cause a precipitous drop in the curves similar to that of the experimental hardboards made at still higher temperatures (Fig. 5). Obviously, the strength properties imparted by the two types of heat treatment are not equivalent even though the modulus values might be identical at some particular value of head speed.

It is possible that the anomalous relationships between modulus of rupture and head speed tested on short spans are caused by the increased tendency for heat-treated materials to fail through high shear stresses developed on such short spans. The fact that high pressing temperatures increase the moduli of elasticity and render the boards more brittle tends to substantiate this possibility. Another possibility is that the heat treatment causes the board to develop plastic properties so that the rate at which stresses are developed within the material no longer bears the same relationship to rate of load application as in the untempered board. In any event, the interrelationships between head speed, modulus of rupture, and span are affected in a complex manner by the heat treatment of the hardboard, and the modulus of rupture does not increase

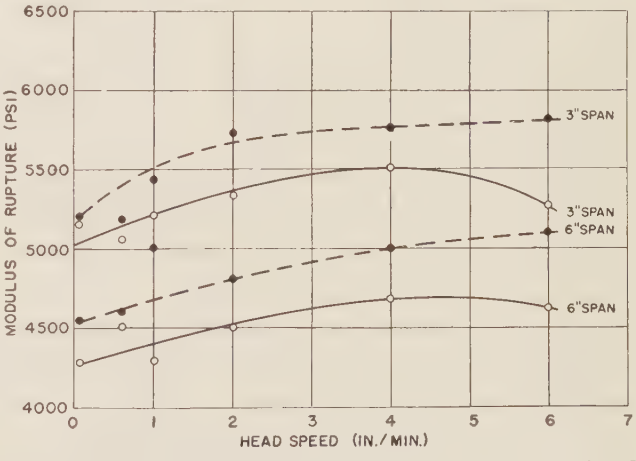


Fig. 4. Relationships between modulus of rupture, head speed, and span for 1/8-in. thick commercial hardboards, showing the effect of heat tempering in an oven for 35 hr. at 284°F. The solid lines represent untempered hardboards and the dotted lines represent heat-tempered boards tested under the same conditions

uniformly with head speed as it does for wood (*3*). It is particularly important, therefore, to avoid very short spans when high head speeds are used in testing hardboard of unknown temperature history.

It should be emphasized that the foregoing discussion

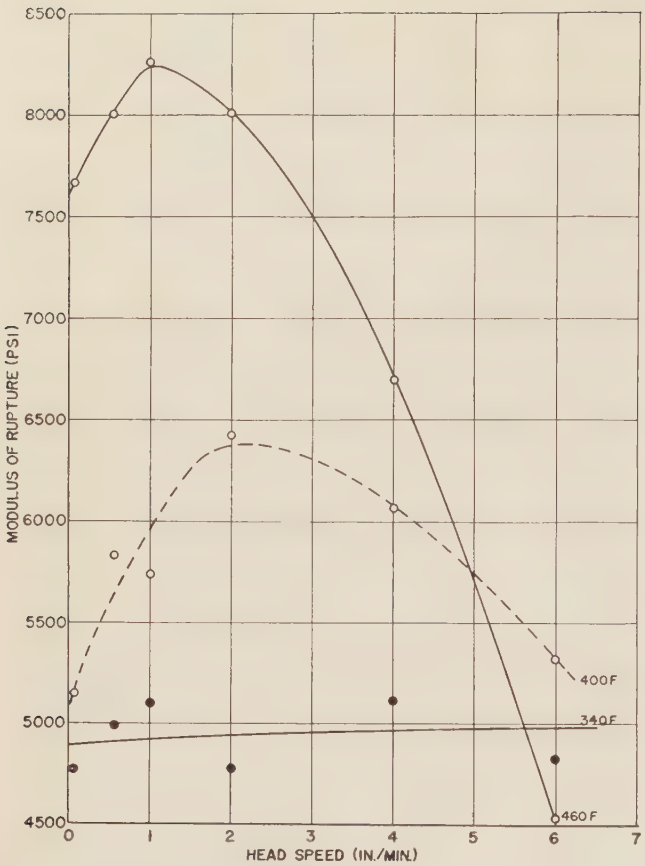


Fig. 5. Relationships between modulus of rupture and head speed for a series of experimental Douglas-fir hardboards pressed at several platen temperatures. The pressing conditions were adjusted to give boards of a uniform specific gravity. The boards were tested on a 2-in. span

of the anomalous relationships between modulus of rupture and head speed applies only to those boards manufactured at high temperature and tested on short spans. If the curves for the longer spans in Figs. 2 and 3 are studied, it will be seen that a head speed of 4 in. per min. represents a relatively level portion for each modulus of rupture curve. Here the variation in modulus of rupture is at a minimum with respect to changes in head speed. Thus, the results of this study seem to indicate that the modulus of rupture values for

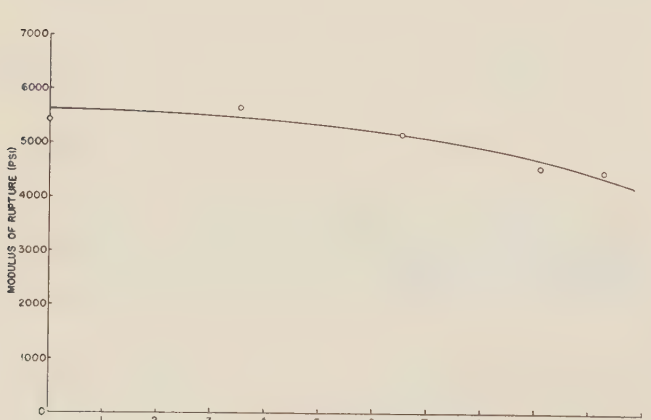


Fig. 6. The effect of moisture content on the modulus of rupture of Douglas-fir hardboard conditioned to equilibrium under various humidity conditions

these boards and for most other boards, whether heat treated or untempered, can be correctly compared at a head speed of 4 in. per min. if a sufficiently long span is used. Further tests should be made of tempered $^1/_8$ and $^1/_4$-in. hardboard over still longer spans than those used in this study.

If the preceding precautions are observed and the excessively short spans are avoided, it will be seen that results with the longer spans corroborate, in general, the results (Fig. 1) of the previous study (*5*). In that study of a nominal $^5/_{32}$-in. Douglas-fir hardboard, modulus of rupture values were virtually constant throughout the longer spans for a range of head speeds from 2 to 6 in. per min. On the 6-in. span, the head speed of 4 in. per min. was chosen as the most satisfactory testing speed because it represented the central portion of the plateau of constant modulus of rupture values. Thus, minor variations in head speed would not affect the modulus of rupture values obtained for this span.

The present study with other hardboards indicates that a 4-in. head speed also gives the least variable modulus of rupture when testing $^1/_8$-in. hardboard on

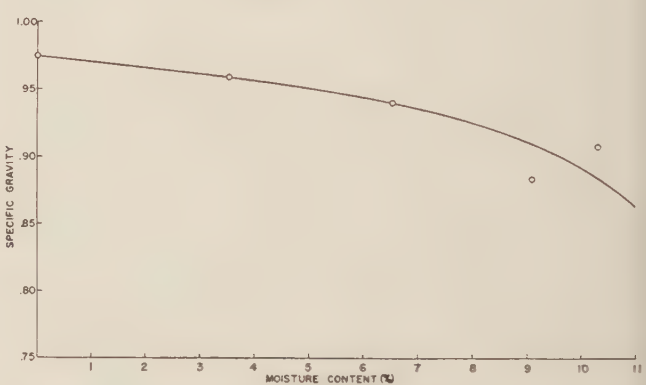


Fig. 7. The effect of moisture content on the specific gravity of Douglas-fir hardboard conditioned to equilibrium under various humidity conditions

a span of 6 in. and $^1/_4$-in. hardboard on a span of 10 or 12 in. These conditions conform much more closely to the requirements for hardboard testing in Federal Specification LLL-F-311, March 9, 1939 (*2*) than to the later proposals included in ASTM designation D 1037-49 T (*1*); the former calls for considerably higher head speeds and longer spans than the latter. A discussion of these specifications and the considerations involved in their formulation were presented in the previous paper (*5*).

LITERATURE CITED

1. American Society for Testing Materials, Tentative Methods of Test for Evaluating the Properties of Building Boards. ASTM Designation D 1037-49 T (1949).
2. Federal Stock Catalog, Federal Specification for Fiberboard, Hard-Pressed, Structural LLL-F-311, March 9, 1939.
3. Liska, J. A., Effect of rapid loading on the compressive and flexural strength of wood. U. S. Forest Products Laboratory Report R1767 (1950).
4. Turner, H. D., Hohf, J. B., and Schwartz, S. L., *Forest Products Research Society Proceedings* 2: 110–112 (1948).
5. Wilcox, H. E., *Tappi* 34, No. 7: 314–316 (1951).

Received May 2, 1952.

ASSOCIATION NEWS AND EVENTS

Local Section Meetings

Pacific: May 21–23, 1953, Joint meeting with Pacific Division, Superintendents Association, Gearhart Hotel, Gearhart, Ore. Annual meeting.

Lake States: May 19, 1953, Butte des Morts Country Club, Appleton, Wis. Annual meeting.

Delaware Valley: April 23, 1953, Engineers Club, Philadelphia, Pa. Panel discussion on "Paper Defects," led by L. P. Thompson, Personal Products Corp., Milltown, N. J. May 28, 1953, Edward J. Albert, Award Program. Paper presentation competition.

Kalamazoo Valley: May 7, 1953, Harris Hotel, Kalamazoo Mich. Western Michigan College Night. Presentation of senior theses.

New England and Maine-New Hampshire: June 19–20, 1953, Poland Spring House, Poland Spring, Me. Joint annual meeting.

Ohio: May 14, 1953, Cincinnati Gas & Electric Co., Hartwell Clubhouse, Cincinnati, Ohio. Annual meeting.

Empire State: June 8–10, 1953, Whiteface Inn, Lake Placid, N. Y. Annual meeting.

Empire State, Northern District: May 14, 1935, Woodruff Hotel, Watertown, N. Y. Annual meeting.

Empire State, Central District: May 1, 1953, University Club, Syracuse, N. Y. College of Forestry, State University of New York. Senior Night. Address by R. G. Macdonald, TAPPI, New York, N. Y. June 5, 1953. Annual meeting.

Empire State, Eastern District: May 21, 1953, Milfranks, Glens Falls, N. Y. Annual meeting.

Lake Erie: May 21–22, 1953, Carter Hotel, Cleveland, Ohio. Measurement and Control Conference.

Southeastern: May 8, 1953, De Soto Hotel, Savannah, Ga.

CPPA Technical Section: June 4–6, 1953, Saranac Inn, Saranac, N. Y. Summer meeting.

American Pulp & Paper Mill Superintendents Association: Atlanta Biltmore Hotel, Atlanta, Ga.

Empire State Section

The Empire State Section has scheduled its annual meeting for the next two years, June 10–13, 1954, and June 9–12, 1955.

The Section has raised the age limit for competition in its Junior Award Contest from 30 to 35 years.

The program of the June 8–10, 1953, meeting of the Section to be held at the Whiteface Inn, Lake Placid, N. Y., follows:

June 9, 1953

"Air Removal from Paper Machine Stock—the Deculator," by G. Hughson, Research & Development Dept., Can. Int'l. Paper Co., Gatineau, Que., and Jack Stewart, Clark & Vicario Co., representing Rotareaed Corp., Bronxville, N. Y.

"Semichemical Pulping of Hardwoods," by H. L. Field, Technical Supervisor, West Virginia Pulp & Paper Co., Mechanicville, N. Y.

"Some Causes and Means of Elimination of Static Electricity," by Lewis E. Walkup, Assistant Supervisor, Graphic Arts Research Div., Battelle Memorial Institute, Columbus, Ohio.

June 10, 1953

"Masking Airborne Malodors—Utilization of Aromatic Chemicals in Industrial Odor Abatement," by B. K. Tremaine, Industrial and Aromatics Section, E. I. du Pont de Nemours & Co., Wilmington, Del.

"Dirt Removal with the Centricleaner," by a representative of Bauer Bros. Co., Springfield, Ohio.

"Atomic Power," by Dr. Edward Fuller, Professor of Industrial Physics, Champlain College, Plattsburg, N. Y.

In addition to the above, if there is an adjudged winner or winners of the Junior TAPPI Awards for the Empire State Section, and if the papers awarded are available, they, too, will be presented at some time during the meeting.

C. N. Hagar, Jr.
R. H. Wiles

Lake Erie Section

The Lake Erie Section will conduct a two-day conference at the Hotel Carter, Cleveland, Ohio, on May 21–22, 1953, on "Measurement and Control of Paper and Paperboard Manufacture and Conversion."

The general chairman of the conference will be J. W. Noll, General Manager of the Monroe Falls Paper Co., Monroe Falls, Ohio.

The program has been prepared in cooperation with the Cleveland Section of The American Society for Quality Control, the Cleveland Section of the Instrument Society of America, and the TAPPI Engineering Div.

L. A. Moore, recently Plant Engineer of The American Coating Mills, Elkhart, Ind., and now Assistant Chief Engineer of The Black-Clawson Co., Hamilton, Ohio, will be the general moderator of the conference.

H. A. Black, the speaker at the dinner, was the 1952 winner of the Bolton Award.

The program follows:

Thursday, May 21

Moderator—L. A. Moore, Assistant Chief Engineer, The Black-Clawson Co., Hamilton, Ohio

9:30 a.m.

1. "Measurements and Controls Presently Available to the Papermaking and Converting Industries—Their Advantages and Limitations," by Ralph W. Peters, Assistant Superintendent, Paper Mill Dept., Eastman Kodak Co., Rochester, N. Y.
2. "What the Papermaker and Converter Would Like to See Measured and Controlled," by William H. Aiken, Technical Director, Gardner Board and Carton Co., Middletown, Ohio.
3. "Instrumentation from Management's Viewpoint," by Sherman C. Lloyd, Electrochemicals Div., E. I. du Pont de Nemours & Co., Inc., Niagara Falls, N. Y.

1:00 p.m. Luncheon

2:30 p.m.

1. "The Instrument Manufacturer's Problems in Meeting the Demands of the Papermaking and Converting Industries," by Henry Ehrisman, Paper Industry Manager, Foxboro Co., Foxboro, Mass.
2. "Process Controls Presently in Use in Other Industries Which Might Be Applied to the Manufacture and Conversion of Paper and Paperboard," by John Green, Steel

Industry Sales Manager, Minneapolis-Honeywell Co., Philadelphia, Pa.

3. "Other Industry" Experience in Measurement and Control Which May Be of Benefit to the Paper Industry," by Irving Lefkowitz (formerly with Seagrams, Inc.), Case School of Applied Science, Cleveland, Ohio.
4. "A Quality Control Program" by John F. Langmaid, Jr., Assistant to Production Manager, S. D. Warren Co., Cumberland Mills, Me. (Chairman, TAPPI Statistics Committee).

5:30–7:00 p.m. Fellowship Period

7:00 p.m. Dinner

"The Greatest Measurement and Control Problem of All—The Human Being," by H. A. Black, Industrial Relations Dept., The Mead Corp., Chillicothe, Ohio.

Friday, May 22

9:00 a.m.

Plant Tours (trips through plants in the Cleveland area outstanding for their use of controls):

Republic Steel Co.—Automatic control of steel webs at 1000 f.p.m.
Ford Motor Co.—"The Plant of Tomorrow" (Automatic control in the manufacture of Ford engines).
Standard Oil Co. of Ohio—Automatic control in one of the largest refineries in the United States.
General Motors, Bailey Meters, etc.

Arm-Chair Tours (Film):

"Principles of Automatic Control," Instrument Society of America (one hour, color and sound).
"Motors in Industry," General Electric Co.

Instrument and Control Exhibits (Daily)

Maine-New Hampshire and New England

The Maine-New Hampshire and New England Sections will meet jointly at the Poland Spring House, Poland Spring, Me., on June 19–20, 1953.

"Graphic Arts" will be the main theme of the meeting. Consideration will be given to the principal processes of printing, such as offset, letterpress, lithography, etc., as well as the methods of office duplication such as ditto, facsimile, etc.

The Arrangements Committee will be comprised of C. I. Horton, J. F. Wright, F. S. Klein, H. E. Pratt, and R. W. Ramsdell.

The members of the Program Committee are A. E. Jones, F. Sprague, F. S. Klein, and George Wallace.

TAPPI 1954 Nominating Committee

The following principals and alternates have been appointed by the Executive Committee to serve as members of the TAPPI 1954 Nominating Committee to prepare a slate of candidates to be voted on by mail ballot prior to the 1954 Annual Meeting of the Association:

Principals:

Nicholas Shoumatoff, West Virginia Pulp & Paper Co., New York, N. Y.
R. H. Hurst, Kalamazoo Vegetable Parchment Co., Kalamazoo, Mich.
C. H. Krebs, Atlas Boxmakers, Inc., Chicago, Ill.
John P. Weidner, Container Corp. of America, Manayunk, Pa.
F. J. Weleber, Publishers Paper Co., Oregon City, Ore.

Alternates:

W. R. Willets, Titanium Pigment Co., New York, N. Y.
A. C. Dreshfield, Chicago Testing Laboratory, Chicago, Ill.
Paul Koenig, P. H. Glatfelter Co., Spring Grove, Pa.
J. L. McCarthy, University of Washington, Seattle, Wash.
A. H. Nadelman, Western Michigan College, Kalamazoo, Mich.

The terms of the following Officers and Executive Committeemen expire in February, 1954:

President: George H. Pringle, Mead Corp., Chillicothe, Ohio
Vice-President: Karl O. Elderkin, Bowaters Southern Paper Corp., Calhoun, Tenn.
Executive Committeemen: Ward D. Harrison, Riegel Paper Corp., Milford, N. J.; W. F. Hathaway, Kalamazoo Vegetable Parchment Co., Kalamazoo, Mich.; W. F. Holzer, Crown Zellerbach Paper Co., Camas, Wash.; R. P. Price, Hammermill Paper Co., Erie, Pa.

Local Section Representatives

The following members of the Executive Committee have been appointed by President Pringle as Official Representative to the TAPPI Local Sections:

Maine-New Hampshire—G. A. Day, Brown Co., Berlin, N. H.
New England—N. I. Bearse, Champion-International Co., Lawrence, Mass.
Delaware Valley—W. D. Harrison, Riegel Paper Corp., Milford, N. J.
Kalamazoo Valley—W. F. Hathaway, Kalamazoo Vegetable Parchment Co., Kalamazoo, Mich.
Ohio—G. H. Pringle, Mead Corp., Chillicothe, Ohio
Lake States—H. F. Lewis, Institute of Paper Chemistry, Appleton, Wis.
Lake Erie—L. K. Burnett, Ohio Boxboard Co., Rittman, Ohio
Chicago—H. C. Moore, Beloit Iron Works, Beloit, Wis.
Pacific—W. F. Holzer, Crown Zellerbach Corp., Camas, Wash.
Southeastern—J. R. Lientz, Union Bag & Paper Corp., Savannah, Ga.
Empire State—C. J. Sibler, West Virginia Pulp & Paper Co., New York, N. Y.

Division Chairmen

President Pringle has appointed the following individuals General Chairmen of the Association Divisions:

Engineering—C. J. Sibler, West Virginia Pulp & Paper Co., New York, N. Y.
Research Development—W. F. Holzer, Crown Zellerbach Corp., Camas, Wash.
Converting and Consuming—L. K. Burnett, Ohio Boxboard Co., Rittman, Ohio
Testing—James d'A. Clark, Longview, Wash.
Pulp Manufacture—George A. Day, Brown Co., Berlin, N. H.
Paper Manufacture—R. P. Price, Hammermill Paper Co., Erie, Pa.
Industrial—Norman I. Bearse, Champion-International Co., Lawrence, Mass.

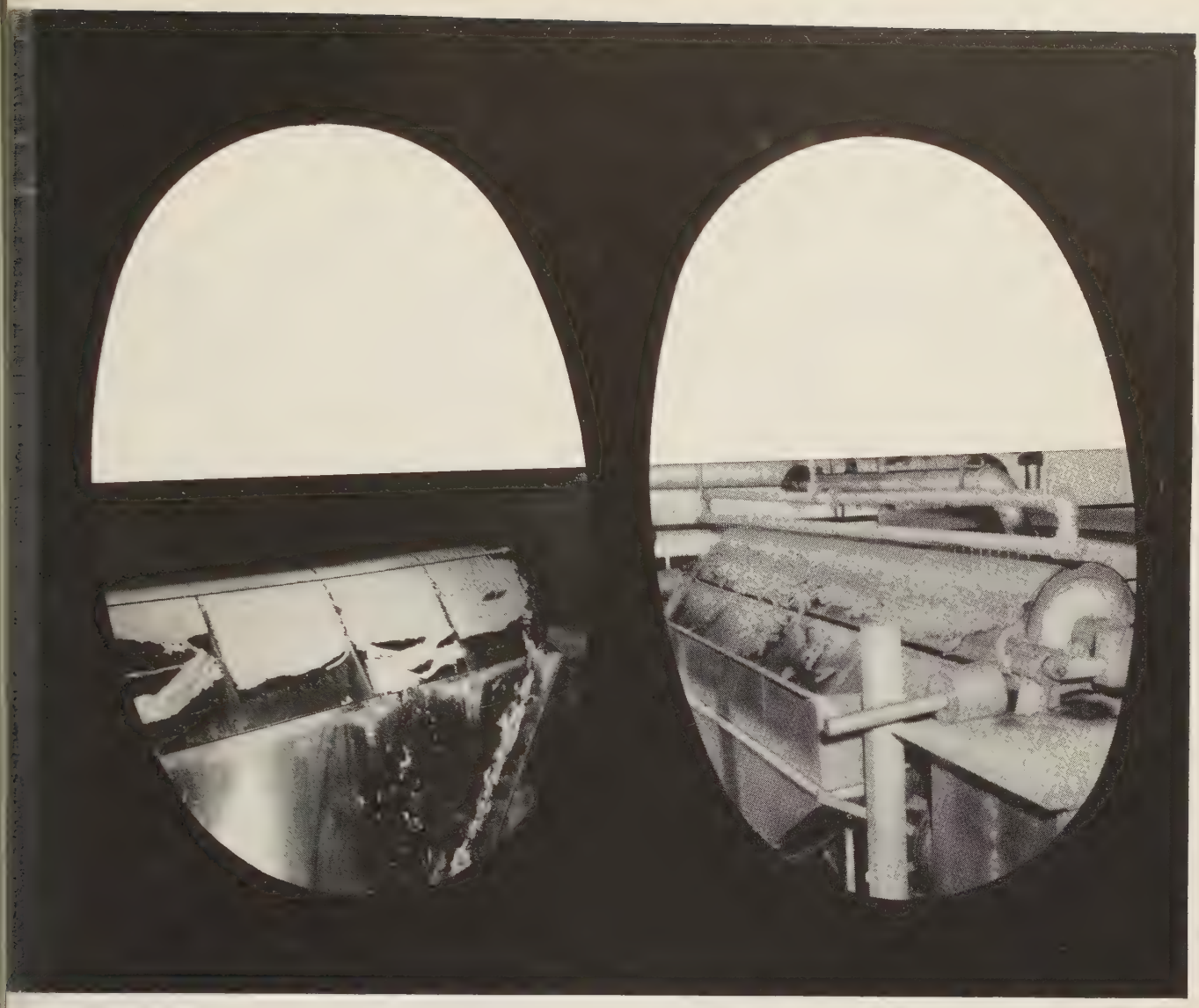
Research Appropriation Committee

The membership of the TAPPI Research Appropriations Committee for 1953–54 is as follows (dates following names indicate time of term expirations):

John L. Parsons, Hollingsworth & Whitney Co., Waterville, Me., Chairman
G. H. Pringle (*ex-officio*), Mead Corp., Chillicothe, Ohio
K. O. Elderkin (*ex-officio*), Bowaters Southern Paper Corp., Calhoun, Tenn.
Allen Abrams (1953), Marathon Corp., Rothschild, Wis.
A. E. Bachmann (1953), Missisquoi Corp., Sheldon Springs, Vt.
H. W. Bialkowsky (1953), Pulp Div., Weyerhaeuser Timber Co., Longview, Wash.
W. F. Gillespie (1954), Gaylord Container Corp., Bogalusa, La.
J. W. Hemphill (1954), Johns-Manville Corp., New York, N. Y.
J. D. Malcolmson (1954), Berkeley, Calif.
A. L. Sherwood (1955), Sutherland Paper Co., Kalamazoo, Mich.
W. H. Swanson (1955), Kimberly-Clark Corp., Neenah, Wis.
K. P. Geohegan (1955), Howard Paper Mills, Dayton, Ohio

Application Statistics Conference

The Conference on Application of Statistical Methods in



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the Pulp and Paper Industry will be cosponsored by TAPPI and Western Michigan College from June 15 to 26, 1953 at Kalamazoo, Mich.

This short course on the application of statistical methods to problems of the pulp and paper industry is first, to acquaint men in the pulp and paper industry with the applicability of statistical methods to their problem. Second, it is designed to give preliminary training to those individuals so that they may use statistical methods in research, production, and quality control.

The program will be conducted by four regular lecturers: Prof. Geoffrey Beall of the University of Connecticut, formerly of The Institute of Paper Chemistry; Charles A. Bicking, Research and Development Div., Ordnance Dept., formerly with Hercules Powder Co.; Charles H. Butler and Fred Beeler, Mathematics Dept., Western Michigan College. Eight evening talks by men from industry will be given.

The first or elementary week, June 15–19, is particularly designed for participants who have not previously used statistics. Men with some experience are advised to consider only the second week. The second week is designed for participants who have previously used statistics to some extent. They are advised to consider only this week. Men who have attended the first week may profitably stay on.

Program of First Week

June 15—Chance variability of measured strength tests and character of the normal distribution.
June 16—Calculation of standard deviation from range and its use and control charts and their application.
June 17—Control charts for range and tests for the significance of a difference ("t" test).
June 18—The chance variation of defects and control charts for fraction defective.
June 19—Application of control charts for defects and design of experiments.
June 22—The analysis of variance and tests of significance in analysis of variance.
June 23—Application of control charts when there is more than one kind of variability, analysis of variability, both in the machine direction and cross-machine direction, and the partition of variance.
June 24—Two-way analysis of variance as an experimental tool and correlation and regression.
June 25—Variability of a regression and correlation of strength characters.
June 26—Continuation of correlation of strength characters, the chance variability of a correlation and calculation of correlation.

Fees to be charged, including room and board are as follows: one week alone $100, with wife $140; two weeks alone $200, with wife $280. The conference will be held if 35 apply. A maximum of 50 will be accepted.

For more information and detail on program or to register for course, write Charles H. Butler, Western Michigan College, Kalamazoo, Mich.

M.I.T.-TAPPI Alumni

The Massachusetts Institute of Technology Alumni Group in TAPPI elected Henry Dimmick of SKF Industries, Philadelphia, Pa., chairman of the group at its luncheon held during the TAPPI Annual Meeting. Mr. Dimmick succeeds K. J. Mackenzie, Eastman Kodak Co., Rochester, N. Y.

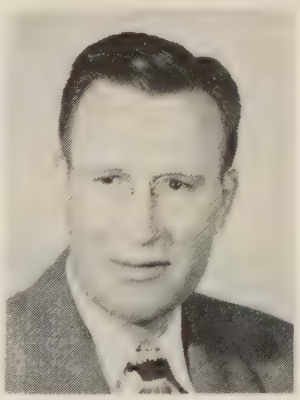
New TAPPI Committee Chairmen

W. Howard Rapson, Professor, Dept. of Chemical Engineering, University of Toronto, Toronto, Ont., has succeeded Robert L. McEwen, Buffalo-Electro-Chemical Co., Buffalo, N. Y., as chairman of the TAPPI Pulp Purification Committee. Mr. McEwen will serve as secretary of the committee.

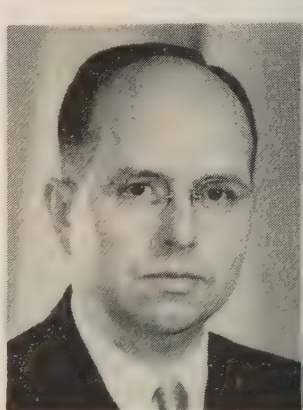
Fred W. Bishop, Southland Paper Mills, Inc., Lufkin, Tex., has succeeded Robert R. Fuller, Gulf States Paper Co., Tuscaloosa, Ala., as chairman of the Alkaline Pulping Committee.

Ralph T. Nazzaro, Westfield River Paper Co., Russell, Mass., has succeeded E. C. Jahn, College of Forestry, State University of New York, Syracuse, N. Y., as chairman of the Plastics Committee. V. T. Stannett of the College of Forestry will continue as secretary of the committee.

B. F. Shema, Institute of Paper Chemistry, Appleton, Wis., has succeeded R. F. DeLong, The Marathon Corp., Rothschild, Wis., as chairman of The Microbiological Committee.



Fred W. Bishop, Southland Paper Mills, Inc.; Chairman, Alkaline Pulping Committee

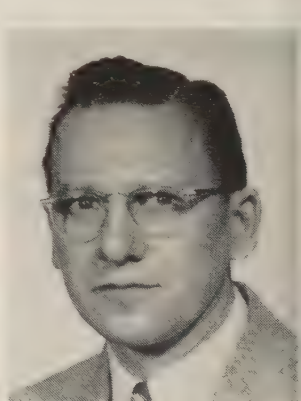


W. Howard Rapson, University of Toronto; Chairman, Pulp Purification Committee

W. H. Aiken, Gardner Board & Carton Co., Middletown, Ohio, has succeeded L. E. Smith, Marathon Corp., Menasha, Wis., as chairman of the Packaging Materials Testing Committee.

Glen T. Renegar, Container Corp. of America, Manayunk, Pa., has succeeded James J. Harrison of the Michigan Carton Co., Battle Creek, Mich., as chairman of The Papermaking (Cylinder) Committee.

Ralph T. Nazzaro, Westfield River Paper Co.; Chairman, Plastics Committee



B. F. Shema, The Institute of Paper Chemistry; Chairman, Microbiological Committee

Burt Mendlin, Cornell Paperboard Products Co., Milwaukee, Wis., has succeeded F. D. Long, Container Corp. of America, Chicago, Ill., as chairman of the Corrugated Containers Committee. W. W. Marteny of the National Container Corp., Tomahawk, Wis., will serve as secretary of the committee.

A. V. Grundy, Quartermaster Food & Container Institute, Chicago, Ill., has succeeded C. H. Krebs, Atlas Boxmakers, Inc., Chicago, Ill., as chairman of the Container Testing Committee. This committee exists also as the Testing Subcommittee of the Container Evaluation and Development Committee of which C. H. Krebs is chairman.

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Colored tissue brings a quick pickup in sales volume. In a window package that lets the color show through, it is an attractive self-merchandiser. The shopper buys *more* tissue products in color when they fit in with the decorative scheme of her kitchen, dining room or bath.

Today's color-conscious shopper turns away from colorless "look-alikes" that have long been sold as standard necessities on the grocer's shelves. With color, these "necessities" become so attractive that they are often sold as *accessories*—resulting in new uses and bigger retail sales.

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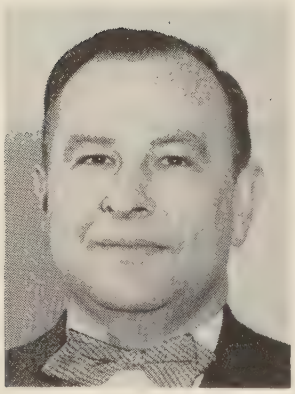
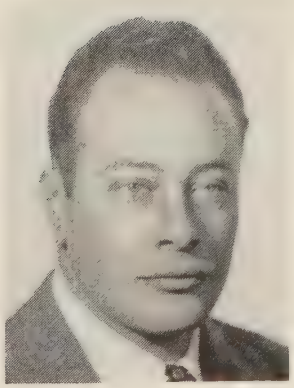


W. H. Aiken, Gardner Board & Carton Co.; Chairman, Packaging Materials Testing Committee



Burt Mendlin, Cornell Paperboard Products Co.; Chairman, Corrugated Containers Committee

Coating Conference

The Fourth Coating Conference of the Technical Association of the Pulp and Paper Industry will be held at the Netherland Plaza Hotel, Cincinnati, Ohio, on May 25–27, 1953.

Program of May 25, 1953

Symposium on Coated Papers in Offset Printing.

A. C. Zettlemoyer, National Printing Ink Research Institute, Bethlehem, Pa., *Chairman.*

1. "Coated Paper and Offset Printing. Part 1," by A. P. Reynolds, S. D. Warren Co. "Part 2," by F. H. Frost, S. D. Warren Co., Cumberland Mills, Me.

Litho inks were designed to favor hard-sized wove papers and also the poor image and nonimage plate areas. Fountain solutions were designed for these inks and plates. Plates were coarse grained to carry heavy water loading, halftones were balanced for coarse grain plates and wove paper. None of these important elements were developed for coated paper. Further, press blankets of natural rubber emboss and rapidly become tacky. Wove papers will release, but not coated paper. Coated litho papers were originally designed for litho label work and not high fidelity printing. Today, progress in materials, methods, and machines has contributed to enhanced qualities of coated paper surface.

2. "Offset Inks for Coated Papers," by F. J. Dankert, Sun Chemical Corp., East Rutherford, N. J.

The problem of lithographic ink as related to the surface of these papers. The factor of viscosity is discussed in relation to these surfaces. An explanation of the type of ink available for coated papers and properties for each. The effect of humidity in relation to picking, register, feeding, etc. Drying problems are discussed.

3. "Offset Printing of Coated Papers," by Charles F. King, U. S. Printing & Lithograph Co., Cincinnati, Ohio.

In addition to the generally accepted properties required of coated stocks for printing on offset lithographic presses, there are some which are generally less recognized. Most of these properties are masked by peculiarities of the operation not known to papermakers and up to the present time have been given neither a name nor numerical designation. Such factors are discussed.

4. "Non-Paper Factors and Quality of Offset Lithography," by David W. S. Riddell, The Montreal Lithographing Co., Ltd., Montreal, P. Q., Canada.

With the introduction of the high-speed rotary offset litho press and its accompanying mass production techniques, the need for precise scientific control of all steps in the lithographic process has been recognized. This paper discusses some of the major variables encountered in camera, plate making, and press operations. Plate making and press factors are specifically covered and emphasis is placed on scientific testing and instrumentation as an aid toward variables.

5. "Operating Factors in Offset Printing on Coated Papers," by Robert F. Reed and Gordon Wheeler. Lithographic Technical Foundation, Chicago, Ill.

One of the principal advantages of the offset lithographic process is its ability to produce high quality printing in halftone and color on papers of widely different surface characteristics. In recent years, however, the trend has been toward the increased use of coated papers, and this has brought about many new developments in the coating field. It has also focused the attention of press manufacturers and lithographers on the precision of press adjustments and on the special requirements for printing plates, blankets, rollers, inks, and fountain waters, necessary to produce the best results in printing on coated stocks. This paper discusses the problems involved and the progress being made in solving them.

6. Panel discussion on Factors Involved in Offset Printing of Coated Paper. *Moderator*—A. C. Zettlemoyer.

Program of May 26, 1953

Symposium on Coated Board.

J. T. Loomer, Robert Gair Co., Uncasville, Conn., *Chairman.*

Following the talks there will be a panel discussion of problems related to the manufacture and use of coated board.

1. "Experiences with the Champion Machine Coater on a Board Machine", by Glenn L. Reneger, Container Corp. of America, Manyunk Div., Philadelphia, Pa.
2. "The Role of Calenders in the Machine Coating of Paperboard", Harry C. Fisher, Gardner Board and Carton Co., Lockland, Ohio.
3. "Consideration in the Installation of High and Low Solids Machine Coaters in a Board Machine", John Waldron Corp., New Brunswick, N. J.
4. "Customer Requirements for Coated Board", O. M. Curtis, Jr., Lord Baltimore Press, Baltimore, Md.

Program of May 27, 1952 (General Session)

1. "Considerations in the Design of a Universal Coating Machine for Paper and Board," by R. J. Jacobs, Dilts Machine Works, Fulton, N. Y.

Current interest in coating machinery indicates a trend wherein extreme versatility is desired in order to handle a wide range of coating materials and webs. This trend has been stimulated by the increased usage of specific coating formulations to improve paper products for specific applications. To meet this requirement, special considerations are required in the design and construction of the coating unit and auxiliary equipment. By a series of diagrams, it is shown how a single coater can be designed to perform most roll coating, air knife, hot melt, gravure, reverse, kiss, and offset operations, by addition or subtraction of various elements in the same frame, and utilizing the same unwinds, oven, cooling section, and winder. Conclusions are drawn on the applicability of the universal machine to laboratory work and limitations in various categories of coating work on commercial machinery.

2. "Physical Properties of Size-Pressed Coated Paper Containing Dow Latex 513-K," by Lloyd Silvernail, Dow Chemical Co., Midland, Mich.

The results of a study of commercially size-pressed coated paper are given. The effect on physical properties of varying the latex to starch ratios is presented. Other variables included are total adhesive content and the partial substitution of clay with titanium dioxide.

3. "An Approach to the Evaluation of Coated Paper Smoothness," by Louis J. Scheid and Arthur Hupp, Watervliet Paper Co., Watervliet, Mich.

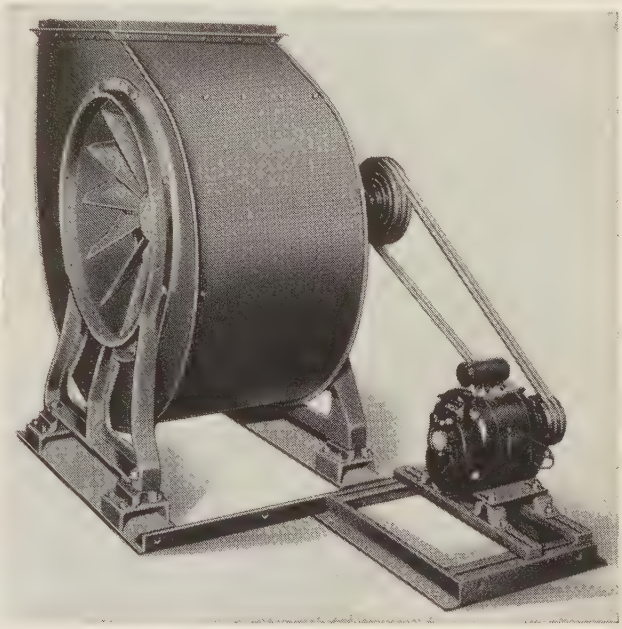
It is generally recognized that existing smoothness tests have serious limitations in the evaluation of coated paper smoothness. An experimental optical smoothness test has been built and operated for over one year. Correlation of results with actual printing experience indicates that the approach may be adaptable to routine use.

Following the presentation of papers on Wednesday, May 27, arrangements are being made to visit the following plants:

Mead Corp., Chillicothe, Ohio (by morning train).
Gardner Board & Carton Co., Middletown, Ohio.
U. S. Printing and Lithographing Co., Cincinnati, Ohio.

"Buffalo" *Tips on Getting the Best Service from your* **Fans**

PICK the RIGHT FAN in the RIGHT SIZE *For Greatest Economy*



"BUFFALO" SINGLE WIDTH TYPE "LL" FAN
Available in a complete size range for accurate selection.

If you are considering a ventilation or air conditioning system, your choice of fan can determine its success or failure. The wrong type of fan may not have the right pressure characteristics in actual operation—may be wastefully inefficient or fall short of the required performance.

For systems in general, the centrifugal fan, such as the "Buffalo" Load-Limit shown here, has the ideal characteristics . . . a stable, rising pressure characteristic . . . freedom from overloading . . . good efficiency over a wide range of capacities and system pressures . . . quiet, dependable performance.

A common fallacy in selecting fan size is to pick one that has a great deal of capacity beyond what is called for. This is wasteful, both in first cost and in driving power. In the "LL" group, it is possible to pick exactly the fan needed to do your expected job—from 600 cfm to 500,000 cfm, for static pressures from ¼" to 6" and higher. Picking the right fan means getting the air you pay for!

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PERSONAL MENTION

Items About New and Old Tappimen

New TAPPI Members

Friedrich A. Aflenzer, Collaborator, U. S. Forest Products Laboratory, Madison, Wis., a 1950 graduate of the University of Technology.

Om P. Aggarwala, Student Trainee, Crown Zellerbach Corp., Camas, Wash., a 1946 graduate of Gordon Mission College, University of the Punjab.

Olavi A. Aho, Chemical Engineer, Research Div., Rayonier, Inc., Shelton, Wash., a 1935 graduate of Washington State College.

Henry S. Ainsworth, Chief Chemist, The Darwen Paper Mill Co. Ltd., Darwen, Lancs., England, a 1950 graduate of Technological Institute.

Warren W. Bolander, Engineer, General Electric Co., Schenectady, N. Y., a 1944 graduate of Stevens Institute of Technology.

Charles J. Bordonaro, Physical Testing Specialist, Philadelphia QM Depot, General Testing Laboratories Div., Philadelphia, Pa., a 1947 graduate of New York State College of Forestry.

Richard S. Bosworth, Plant Engineer, Claremont Paper Mill, Claremont, N. H. Attended Norwich University.

Joseph Brown, Sales Dept., The Tupman Thurlow Co., Inc., New York, N. Y.

Nathan H. Carpenter, Assistant Superintendent, Muskingum Fiber Products Co., Coshocton, Ohio. Attended Cornell University.

Robert R. Childs, Chemical Engineer, Buckeye Cotton Oil Co., Memphis, Tenn., a 1948 graduate of the University of Florida.

Paul E. Claus, Development Engineer, Gaylord Container Corp., St. Louis, Mo., a 1949 graduate of Washington University.

Lloyd M. Cooke, Manager, Cellulose and Casing Research Dept., The Viking Corp., Chicago, Ill., a 1937 graduate of the University of Wisconsin, with a Ph.D. degree from McGill University in 1941.

Marshall W. Cronyn, Assistant Professor, Reed College, Portland, Ore., a 1940 graduate of Reed College, with a Ph.D. degree from the University of Michigan in 1944.

Merchant L. Cushing, Chief Paper Chemist, Stein, Hall & Co., Inc., New York, N. Y., a 1937 graduate of Columbia University, with a Ph.D. degree in 1941.

Willem L. J. de Nie, Assistant Manager, Shell Chemical Corp., New York, N. Y., a graduate of the University of Leiden and a 1937 graduate of the Technical University, Delft, with a Ph.D. degree.

Amin-nd Din, Superintendent of Industries, Hinde & Dauch Paper Co., of Canada, Toronto, Ont., Canada, a 1931 graduate of Islamia College.

Frank R. Eberhard, Chemist, Robert Gair Co., Inc., Piermont, N. Y., a 1951 graduate of New York University.

David C. Edmiston, Sr., Superintendent of Power, Southland Paper Mills, Inc., Lufkin, Tex.

Robert R. Forrest, Assistant Manager, Pulp and Paper Div., Canadian Vickers Ltd., Montreal, P. Q., Canada, a 1939 graduate of Heriott-Watt College.

Manning C. Freeland, Engineer, J. E. Sirrine Co., Greenville, S. C., a 1952 graduate of Clemson Agricultural and Mechanical College.

Luther P. Gause, Jr., Chemical Engineer, Buckeye Cotton Oil Co., Memphis, Tenn., a 1952 graduate of the University of Alabama.

Elmore E. Graham, Superintendent, Highland Box Co., Highland, Ill.

Anthony J. Greco, Chemist, Merrimac Paper Co., Inc., Lawrence, Mass., a 1949 graduate of Tufts College.

John A. Greer, Jr., Chief Chemist, International Paper Co., Natchez, Miss., a 1939 graduate of Georgia School of Technology.

James J. Grovenstein, Research Engineer, Hudson Pulp & Paper Corp., Palatka, Fla., a 1949 graduate of Alabama Polytechnic Institute and a 1952 graduate of the University of Florida.

William F. Hunnewell, Research Chemical Engineer, Robert Gair Co., Inc., Uncasville, Conn., a 1938 graduate of the University of Maine.

Deokinandan Jain, in Charge of Paper Processing Dept., Rohtas Industries Ltd., Dalmianagar, P.O. Bihar, India, a 1938 graduate of Agra College, Agra.

Gerhard H. Klouman, Market Engineer, Armco Steel Corp., Middletown, Ohio, a 1944 graduate of Purdue University.

Robert W. Long, Salesman, Pulp & Paper Trading Co., New York, N. Y.

Clement F. Lovely, Salesman, Philadelphia Quartz Co., Philadelphia, Pa., a 1933 graduate of St. Louis University.

Werner Mader, Managing Director, Perlen Paper Mill, Perlen, nr. Lucerne, Switzerland, a 1939 graduate of Staatl. Hochschule für angewandte Technik.

Harry L. Mahl, Jr., Chemical Engineer, Gulf States Paper Corp., Tuscaloosa, Ala., a 1950 graduate of Georgia Institute of Technology.

Richard W. Maley, Project Engineer, Great Northern Paper Co., Millinocket, Me., a 1951 graduate of Clarkson College of Technology.

Paul Mangold, Consulting Engineer, Geneva, Switzerland, a 1914 graduate of the Technical University, Karlsruhe, with a Eng.D. degree.

Thomas A. Martone, Jr., Sales Development, E. I. du Pont de Nemours & Co., New York, N. Y., a 1939 graduate of Franklin and Marshall College.

Priyavadan C. Mehta, Head, Chemistry Div., Ahmedabad Textile Industry's Research Association, Navrangpura, Ahmedabad, India, a 1948 graduate of Princeton University with a Ph.D. degree.

Karl F. Miles, Technical Service Supervisor, Mead Corp., Chillicothe, Ohio, a 1939 graduate of Ohio State University.

Robert D. Mounts, Chemical Engineer, Union Bag & Paper Corp., Savannah, Ga., a 1952 graduate of Cornell University.

Frederick R. Mullins, Project Engineer, Great Northern Paper Co., Millinocket, Me., a 1942 graduate of Queens University.

Charles E. Murray, Wood Technologist, Rayonier, Inc., Shelton, Wash., a 1948 graduate of New York State College of Forestry.

Gerhard L. Oscarson, Chief Application Engineer, Electric Machinery Mfg. Co., Minneapolis, Minn., a 1922 graduate of the University of Minnesota.

D. Donald Page, Assistant Superintendent, Paper Mill, West Virginia Pulp & Paper Co., Williamsburg, Pa., a 1936 graduate of New York State College of Forestry.

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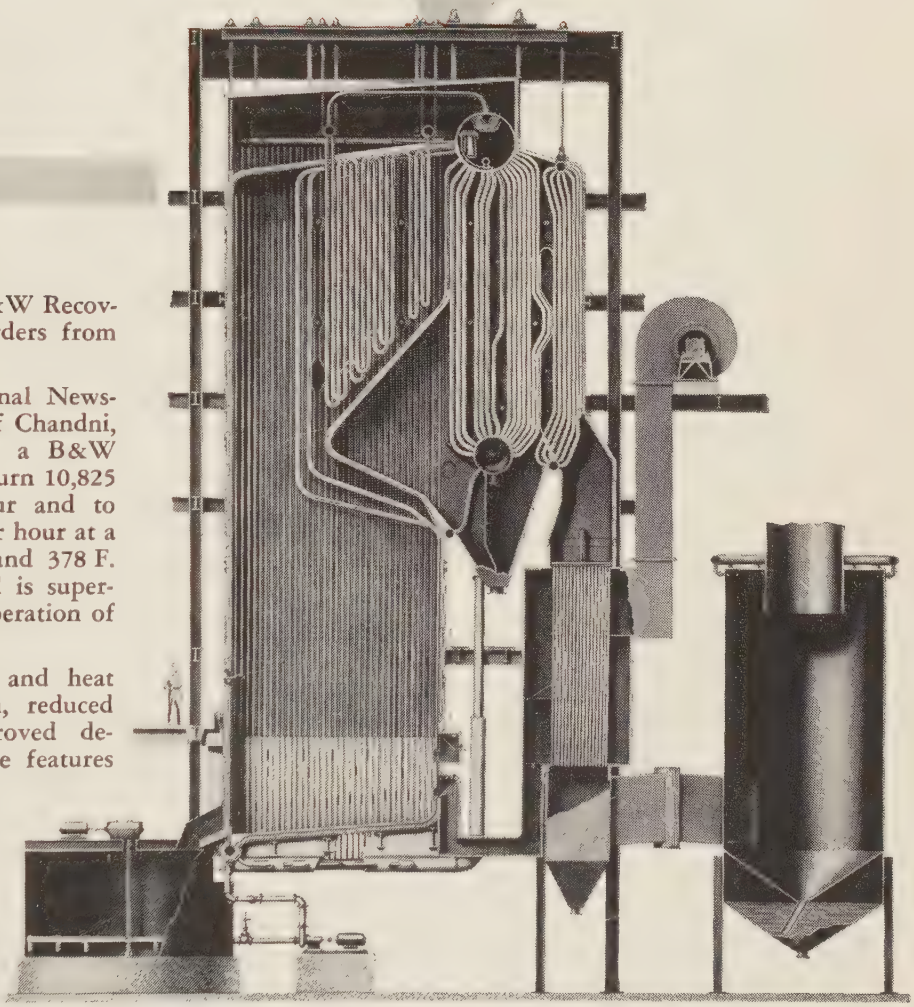
World-wide confidence in B&W Recovery Units is indicated by orders from mills all over the globe.

Now on order for National Newsprint & Paper Mills, Ltd., of Chandni, Central Provinces, India, is a B&W Recovery Unit designed to burn 10,825 lb of black liquor per hour and to deliver 19,800 lb of steam per hour at a design pressure of 200 psi and 378 F. Ebasco Services Incorporated is supervising the installation and operation of this plant.

Highly efficient chemical and heat recovery, low-cost operation, reduced maintenance, and service-proved dependability, are some of the features responsible for a B&W reputation that is fast becoming known wherever pulp and paper mills operate. The Babcock & Wilcox Company, Boiler Division, 161 E. 42nd Street, New York 17, N. Y.



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BOILER DIVISION

P-775

Raoul Pantaleoni, Director, van Amerigen-Haebler, Inc., New York, N. Y., a 1936 graduate of the College of the City of New York.

Walter B. Parker, Assistant Chief Engineer, The Hartford Steam Boiler Inspection and Insurance Co., Hartford, Conn., a 1933 graduate of the University of Tennessee.

Albert E. Penney, Manager, Pulp and Paper Div., Brown Co., Berlin, N. H., a 1937 graduate of the University of Toronto.

Walter Placzankis, Technical Service Representative, E. I. du Pont de Nemours & Co., Grasselli Chemicals Dept., Chicago, Ill., a 1932 graduate of Bowdoin College.

W. Howard Rapson, Professor of Chemical Engineering, University of Toronto, Toronto, Ont., Canada, a 1934 graduate of the University of Toronto with a Ph.D. degree in 1941.

Emmett P. Ryan, Chief Chemist, The Curtis Publishing Co., Philadelphia, Pa., a 1928 graduate of Polytechnic Institute of Brooklyn.

Barrett L. Scallet, Director, Corn Products Sec., Central Research Dept., Anheuser-Busch, Inc., St. Louis, Mo., a 1946 graduate of Washington University with a Ph.D. degree.

Henry W. Seibel, Laboratory Supervisor, Research and Development Div., Gaylord Container Corp., St. Louis, Mo., a 1948 graduate of Washington University.

T. Grant Sheridan, Assistant Superintendent, Chlorine Plant, Howard Smith Paper Mills Ltd., Cornwall, Ont., Canada, a 1947 graduate of the University of Toronto.

Stanley E. Sorrell, Director, Sterling Coated Materials Ltd., Albion Mills, Stalybridge, Cheshire, England. Attended Chelsea Polytechnic Institute.

Krishan K. Talwar, Student, The Institute of Paper Chemistry, Appleton, Wis., a 1948 graduate of Khalsa College, Amritaar, India.

Stephen H. Tyng, Technical Sales Manager, Naugatuck Chemical Div., United States Rubber Co., Boston, Mass. Attended Harvard University.

Morris Wayman, Technical Director, Columbia Cellulose Co. Ltd., Prince Rupert, B. C., Canada, a 1936 graduate of the University of Toronto, with a Ph.D. degree in 1941.

Roy P. Webber, II, Project Officer, Paper Research and Development, U. S. Air Force, a 1952 graduate of the University of Maine.

Lawrence T. Welch, Chemical Engineer, Research Dept., Howard Smith Paper Mills Ltd., Cornwall, Ont., Canada, a 1951 graduate of the University of Toronto.

Irving D. Wells, Mill Manager, The Champion Paper & Fibre Co., Pasadena, Tex. Attended Massachusetts Institute of Technology.

Kenneth S. Whisler, Chemist, P. H. Glatfelter Co., Spring Grove, Pa., a 1935 graduate of Lebanon Valley College.

John E. Wilbur, Supervisor, S. D. Warren Co., Cumberland Mills, Me., a 1948 graduate of the University of Maine.

TAPPI Notes

Henry R. Adams, formerly of Bloedel, Stewart & Welch, is now Pulp Mill Superintendent for the Container Corp. of America, Fernandina Beach, Fla.

Denton Anderson, is now Vice-President of the Plax Corp., West Hartford, Conn.

Paul D. Applegate, of the Hercules Powder Co., has transferred from Holyoke, Mass., to Kalamazoo, Mich.

Cecil H. Baldwin, Technical Director of the Marinette Paper Co., has transferred from Marinette, Wis., to Fort Edward, N. Y.

Arthur Bernhardt is now Assistant Superintendent of the Nekoosa-Edwards Paper Co. pulp mill at Nekoosa, Wis.

Robert B. Blakeslee is now Chief Chemist of the Imperial Paper & Color Corp., Glens Falls, N. Y.

H. M. Blandin, formerly Chief Chemist of the Central Fibre Products Co., is now with Consolidated Paper Co., Monroe, Mich.

Russell A. Buck is now Chief Chemist of the Sorg Paper Co., Middletown, Ohio.

James M. Burt, formerly Technical Director, is now Sales Manager of the Hurlbut Paper Co., South Lee, Mass.

Philip D. Caine is now Manager of the New England Sales Territory of the Becco Sales Co., Boston, Mass.

Walter J. Cassidy is now Product Development Manager for the Sorg Paper Co., Middletown, Ohio.

John W. Close, formerly Chief Chemist, is now General Sales Manager of United Wallpaper Co., Inc., Aurora, Ill.

R. G. Cohn is now Pulp Mill Superintendent of the St. Regis Paper Co., Pensacola, Fla.

Paul B. Corning, formerly of Rayonier, Inc., is now Engineer for Peter J. Schweitzer, Inc., Elizabeth, N. J.

L. C. Currier is now Vice-President in Charge of Operations of the Sorg Paper Co., Middletown, Ohio.

Edwin C. Daniels is now Plant Superintendent of Texon, Inc., South Hadley Falls, Mass.

Eugene de Luca, formerly of the Irving Pulp & Paper Co., is now with the Alaska Pine & Cellulose, Ltd., Vancouver, B. C., Canada.

Donald M. Ferguson is now Beater Room Superintendent of the St. Regis Paper Co., Deferiet, N. Y.

Gilbert Frank, formerly of Cartonneries de la Rochette, is now Chemical Engineer for Papeteries du Drac, Grenoble, France.

George H. Gallaway is now Resident Manager of the Crown Zellerbach Corp., Camas, Wash.

Donald J. Goodman is now Technical Superintendent of Paper Manufacture for the Sorg Paper Corp., Middletown, Ohio.

Lloyd E. Goodwin, formerly Chief Chemist, is now Assistant Pulp Mill Superintendent of the St. Regis Kraft Corp., Eastport, Fla.

L. Otis Green, of Saturating Papers, has moved from 226 W. Randolph St. to 230 S. Wells St., Chicago 6, Ill.

James D. Griffin is now operating the Glenfal Bag & Liner Co., Glens Falls, N. Y.

Pralhad S. Hangel, formerly student at the University of Maine, has joined the Research Div. of the Oxford Paper Co., Rumford, Me.

Herbert L. Hergert, formerly student of Oregon State College is now Research Chemist in the Oregon Forest Products Laboratory, Corvallis, Ore.

Harry F. Highfield, formerly of the Sangamon Paper Mills, Inc., is now Superintendent of the Liberty Paper Board Co., Steubenville, Ohio.

Frank J. Hoffman is now Production Development Specialist for Converted Grades, Sorg Paper Co., Middletown, Ohio.

Fred Holt, formerly Technical Director, is now Vice-President of the Brown-Bridge Mills, Inc., Troy, Ohio.

H. Maxwell Hughson is now Chief Chemist of Provincial Paper Ltd., Port Arthur, Ont.

Marsden C. Hutchins, formerly of the American Cyanamid Co., is now Chemical Engineer for the Johns-Manville Research Center, Manville, N. J.

A. T. Hurter, of Stadler, Hurter Co., Montreal, P. Q., was elected recently President of the Association of Consulting Engineers of Canada.

O. F. Hutchinson is now Vice-President of Bulkley, Dunton Processes, Inc., New York, N. Y.

Richard J. Krueger is now Technical Assistant to the Superintendent, Sorg Paper Co.

Richard D. Lewis, formerly of Finch, Pruyn & Co., Inc., is now Chemist for the Riegel Paper Corp., Milford, N. J.

Harold M. Johnston, is now Sales Manager for General Mills, Inc., Minneapolis, Minn.

John P. Kennedy, formerly Superintendent of Champion-International Co., is now with Modena Paper Mills, Inc., Modena, Pa.

Lloyd Lang is now Consultant for the Improved Machinery Corp., Nashua, N. H.

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If you are planning or building a new mill, your Hooker technical service man can help you:

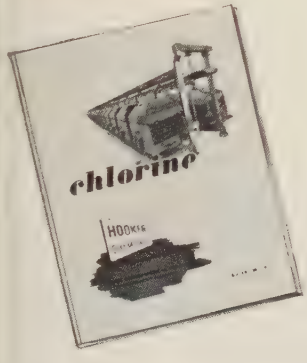
- arrive at chemical requirements
- determine how chlorine and caustic soda will be handled
- select equipment and check plant construction
- test chlorine lines
- make preliminary batch of bleach liquor
- start evaporators and other equipment

On a mill already in operation, your Hooker man can serve you by:

- checking quality and quantity of chemical shipments on arrival
- offering helpful advice when you are changing a process
- developing safety programs, in cooperation with your engineering department, plant employees, and local authorities
- providing helpful tips on bleach liquor making, reducing sludge losses, pulp washing
- assisting on color reversion problems

Behind Hooker technical service is a record of nearly 50 years in supplying your industry with chlorine, caustic soda, and other chemicals of uniform dependable quality.

Call us now - **Let us serve you often.**



New 76-Page Manual

Describes pulp chlorination, production of lime bleach, preparation of soda bleach, analysis of hypochlorite solutions, equipment and methods for handling chlorine, and Hooker services available. For your free copy, write on your business letterhead to Hooker Electrochemical Company, 4704 Buffalo Avenue, Niagara Falls, N. Y.

From the Salt of the Earth

HOOKER ELECTROCHEMICAL COMPANY

NIAGARA FALLS • TACOMA • NEW YORK • CHICAGO • LOS ANGELES

HOOKER CHEMICALS

2-1932

Arthur Levensailor, of the Great Northern Paper Co., has transferred from Millinocket to Madison, Me.

Leslie G. McCowan is now Technical Assistant to the Superintendent, Sorg Paper Co., Middletown, Ohio.

K. A. McMullin is now Manager of the New England Branch of the Stephens-Adamson Mfg. Co., Boston, Mass.

A. G. Natwick, formerly of The Crown Zellerbach Corp., is now Production Manager of The East Texas Pulp & Paper Co., Evadale, Tex.

John F. Nolan is now Technical Assistant to the Superintendent, Oglesby Mill, Sorg Paper Co., Middletown, Ohio.

Richard A. Nugent, formerly Superintendent of the Nekoosa, Wis., mill of the Nekoosa-Edwards Paper Co., has assumed new responsibilities consisting of plans to expand and improve the Port Edwards and Nekoosa mills of the company.

Frederic W. O'Neil is now Head of the Pulp and Paper Technology Dept. of the College of Forestry, State University of New York, Syracuse, N. Y.

Truman A. Pascoe is now Research Director of Nekoosa-Edwards Paper Co., Port Edwards, Wis.

Morley E. Patterson is now Resident Manager of Pacific Mills, Ltd., Ocean Falls, B. C.

Carl E. Price, formerly of the Celanese Corp. of America, is now with the Research and Development Dept., Cellophane Div., Olin Industries, New Haven, Conn.

R. H. Stevens, formerly of the National Container Corp., is now Research Associate for the Herty Foundation Laboratory, Savannah, Ga.

Louis T. Stevenson, formerly Economist for the American Paper and Pulp Association, is now Consultant for Tucker, Anthony & Co., New York, N. Y.

D. C. Tapadar, Chief Chemist of India Paper Pulp Co., Ltd., Hazinager, West Bengal, India, has received a Ph.D. degree from the University of Calcutta. The subject of his thesis was "Paper Technology with Special Reference to Improvements Upon Some Unit Operations."

Fred Waugh, formerly Box Plant Manager for Ball Bros. Co., Inc., is now Works Manager of Stone Container Corp., Mansfield, Ohio.

Daniel F. Williamson, formerly of Sandwell & Co., Ltd., is now Operating Manager of the Howe Sound Pulp Co., Ltd., Port Mellon, B. C., Canada.

Bruce H. Wright, formerly of the Crown Zellerbach Corp., is now Product Coordinator, Staff Technical Dept., Scott Paper Co., Chester, Pa.

Carl J. Wynstra, formerly of the Container Corp. of America is now Chief Chemist for the Central Fibre Products, Co., Quincy, Ill.

* * *

A. G. Lynn has succeeded *J. D. Malcolmson,* retired, as the official corporate representative of the Robert Gair Co., New York, N. Y., in TAPPI.

F. Farquharson has succeeded *H. Godfrey* as the official corporate representative of E. S. & A. Robinson (Canada) Ltd., Leaside, Toronto, Ont., in the Technical Association.

Ronald H. Hynes, President, has succeeded *E. S. Wilsey,* deceased, as the official corporate representative of Newton Falls Paper Co., Newton Falls, N. Y.

F. Ceniceros, General Manager, has succeeded *Victor Vidal* as the official corporate representative of Cia. Industrias de Atenquique, S. A. Atenquique, Mexico.

* * *

Norman H. Nuttall is now the official representative of Stein, Hall & Co., Inc., New York, N. Y., in TAPPI succeeding *Lawrence Gussman.*

F. H. Cole has succeeded *A. S. Eichler* as the official representative of the Walworth Co., New York, N. Y., in TAPPI.

Industry Notes

Production

Production of paper and board in January, 1953, amounted to 2,124,000 tons; about the same as production in January, 1952.

Wood pulp production in 1952 totaled 16,467,000 tons, a decline of less than 1% under production for 1951.

Consumption of wood pulp in 1952 amounted to 17,274,000 tons, a decline of 3% under 1951 consumption.

Wood pulp imports for 1952 amounted to 1,937,000 tons, 18% under imports for the previous year. Imports from Europe were down 26%, and from Canada 16%.

Exports of wood pulp in 1952 reached 211,000 tons, a 28% increase over exports for 1951.

Wastepaper receipts for 1952 reached 7,813,000 tons, a decline of 16% under receipts for 1951.

Consumption of wastepaper in 1952 amounted to 7,881,000 tons, a decline of 13% under 1951.

Receipts of pulpwood for 1952 totaled 27,233,000 cords, a decline of 2% under receipts for 1951. Domestic receipts of 24,918,000 cords were down 1% and imports of 2,315,000 cords were down 12%.

Consumption of pulpwood in 1952 amounted to 26,416,000 cords, about the same as the consumption in 1951.

Wood Pulp

The following table shows the U. S. imports of wood pulp by grades (thousands of tons):

Grade	*1952*	*1951*
Sulphite	931	1137
Rayon and special	223	231
Other bleached	275	349
Unbleached	433	557
Sulphate	727	858
Bleached	519	522
Unbleached	208	336
Soda	28	33
Groundwood	242	318
Bleached	34	17
Unbleached	208	301
Screenings	8	15

Paper

Preliminary statistics for paper output for 1952 is as follows:

Production, tons	24,520,000
Capacity	26,532,865
Per cent capacity	92
Consumption	29,020,000
Per capita consumption, lb.	369.6

Certificates of Necessity

Forty-three certificates were issued to pulp mills amounting to $305,322,000. The value in place on Dec. 31, 1952, was 66% ($200,729,000). Sixty-three certificates were issued for paper and board mills. The value in place on Dec. 31, 1952, was 46% ($171,333,000).

Water Quality

The State Pollution Control Board, Sacramento, Calif., has issued a 512-page book on "Water Quality Criteria" (SWPCB Publication No. 3).

Pulpwood

Northeastern Wood Utilization Council, P.O. Box 1577, New Haven 6, Conn., has issued a 76-page bulletin (No. 40) on "Pulpwood from Small Woodlands."

Regulate surface density precisely, effectively

KELSIZE or one of the KELGINS

Superior Surface Control Agents

These hydrophilic colloids effectively regulate surface density when applied as a 0.20% to 3.5% solution from calender stack or size press, and effectively control penetration of adhesives, starch solutions, or any water base solution.

You secure these important advantages: Uniformly smooth finish—Uniform density • Improved Gloss and Flat Ink Printing • Greater Wax and Oil Resistance • Smoother and More Uniform Coating Base.

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Try Kelsize or Kelgin and

Measure the difference!

Picture of Gurley Densometer • Courtesy of W. & L. E. Gurley

DYESTUFFS
and
AUXILIARIES
for the Paper Industry

★ BEATER ★ CALENDER

★ COATING MACHINE

★ ANILINE PRINTING

Geigy
DYESTUFF MAKERS SINCE 1859

GEIGY COMPANY, INC.
89-91 BARCLAY STREET, NEW YORK 8, NEW YORK
BRANCH OFFICES: BOSTON • CHARLOTTE, N. C. • CHICAGO • LOS ANGELES
PHILADELPHIA • PORTLAND, ORE. • PROVIDENCE • TORONTO
IN GREAT BRITAIN: The Geigy Co., Ltd., Manchester

United States Production Paper and Board Production in 1952, 1951, and 1950

(Tons of 2000 lb.)

	1952 preliminary	*1951*	*1950*
All Types, Total	24,413,212	26,048,143	24,375,083
Paper, total	10,895,800	11,624,727	10,638,797
Newsprint	1,106,351	1,108,165	1,013,346
Groundwood paper	808,812	790,621	705,329
Paper machine-coated	1,096,251	1,112,990	1,020,002
Book paper	1,482,488	1,610,450	1,578,795
Fine paper	1,295,179	1,366,425	1,197,309
Coarse paper (including shipping sack)	3,235,021	3,627,072	3,298,457
Special industrial paper	396,251	408,381	341,230
Sanitary tissue	1,148,467	1,243,858	1,148,351
Tissue paper (except sanitary and thin)	209,181	229,174	216,865
Absorbent paper	117,799	127,591	119,113
Paperboard, total	10,776,452	11,620,048	10,925,232
Liners	3,904,796	4,213,328	3,872,051
Corrugating material	1,583,472	1,784,163	1,633,575
Container chip and filler board	282,044	325,291	324,651
Folding boxboard	2,193,986	2,362,356	2,351,955
Special food board	796,994	772,541	654,748
Other bending board	154,328	136,682	124,435
Setup boxboard	687,078	733,475	711,805
Other nonbending board	95,546	143,317	164,471
Special paperboard stock	1,008,801	1,063,597	1,000,793
Cardboard	69,407	85,298	86,748
Wet-machine board	137,205	148,381	166,237
Construction paper and board, total	2,603,755	2,654,987	2,644,817
Building paper and insulation	1,298,300	1,385,691	1,425,249
Hardboard	425,081	343,552	381,201
Insulating board	880,374	925,744	838,367

Source: Data for 1952 represent a summation of the monthly Facts for Industry releases (Series M14A), revised to include late and corrected reports. Data for 1951 and 1950 are from Facts for Industry Series M14F-01. "Paper and Board Production: 1951."

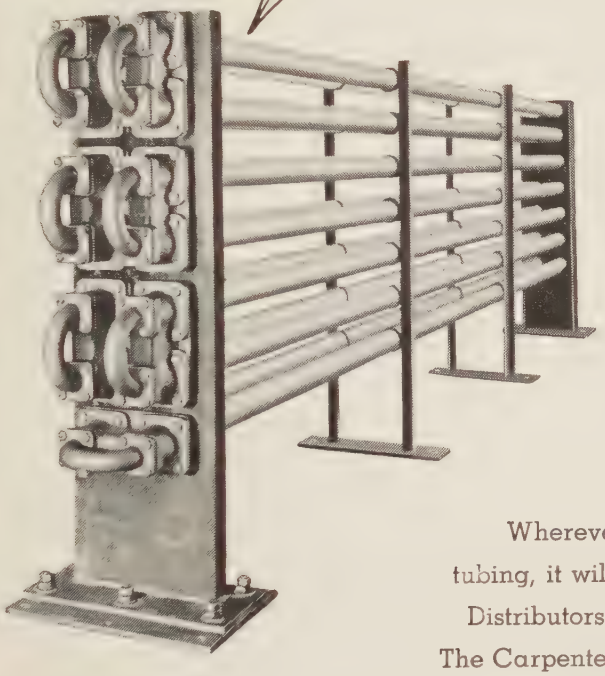
United States Production of Wood Pulp and Consumption of Wood Pulp, Pulpwood, and Other Fibrous Materials in the Manufacture of Paper and Board, by Kinds, 1952, 1951, and 1950

(Tons of 2000 lb.)

	Production			*Consumption*		
	1952 preliminary	*1951*[a]	*1950*[a]	*1952 preliminary*	*1951*[a]	*1950*[a]
Wood Pulp, Total	16,466,810	16,524,408	14,848,951	17,273,682	17,736,970	16,508,905
Special alpha and dissolving grades	706,033	616,202	478,849	71,362[b]	152,257	139,846
Bleached sulphite	1,691,523	1,760,685	1,628,692	1,943,624	2,036,800	2,029,399
Unbleached sulphite	675,212	764,640	740,895	1,027,176	1,203,487	1,246,876
Bleached sulphate	2,082,844	1,899,014	1,432,945	2,495,308	2,382,682	1,861,597
Semibleached sulphate	275,062	293,584	359,917	307,543	330,133	389,436
Unbleached sulphate	6,210,798	6,379,172	5,708,567	6,328,350	6,596,611	6,129,791
Soda	425,415	446,260	522,221	463,478	484,337	559,143
Groundwood	2,379,740	2,473,796	2,215,883	2,608,318	2,751,659	2,482,732
Semichemical	821,153	796,546	685,906	820,350	796,819	685,461
Defibrated or exploded	1,059,124	944,776	934,666	1,063,944	943,657	931,944
Screenings, damaged, etc.	139,906	149,733	140,410	144,229	158,528	152,680
Other Fibrous Materials, Total	....	....	....	9,079,954	10,513,576	9,395,374
Wastepaper	....	....	....	7,881,035	9,070,554	7,956,036
Straw	....	....	....	315,872	402,276	405,618
Rags	....	....	....	324,560	387,843	441,894
Cotton fiber	....	....	....	14,044	16,969	21,286
Manila stock	....	....	....	38,272	44,541	39,883
All other	....	....	....	506,171	591,393	530,657
	Cords of 128 Cu. Ft.—Roughwood Basis					
Pulpwood, Total	....	....	....	26,462,219	26,521,795	23,627,217
Softwood	....	....	....	22,662,381	22,768,368	20,405,910
Hardwood	....	....	....	3,799,838	3,753,427	3,221,307

[a] Revised.
[b] Wood pulp consumption reported by plants classified outside paper and board industries amounted to 753,978 tons in 1952, of which alpha and dissolving grades amounted to 675,452 tons. Comparable data for 1951 amounted to 713,840 tons, of which 671,974 tons were alpha and dissolving grades. Comparable data are not available for the year 1950.
Source: Data represent a summation of the monthly Facts for Industry reports (Series M14A) for the industry, revised to include late and corrected reports received subsequent to the publication of the monthly releases.

Carpenter Stainless Tubing
KEEPS PROCESSES GOING ON SCHEDULE



Modern heat exchanging equipment like this heater/cooler used in a large Wisconsin paper mill has to stay on the job. You can't afford to interrupt a process for hours or days to replace tubes.

That's why the manufacturer of these units selected Carpenter Stainless Tubing, Type 316. In addition to providing good resistance to the corrosive effects of sulphite waste liquor, Carpenter tube quality and uniformity help to make the 20th unit as good as the first.

Wherever a product or process involves corrosion-resistant tubing, it will pay to put Carpenter experience to work for you. Distributors are located in principal cities from coast to coast.
The Carpenter Steel Company, Alloy Tube Division, Union, N. J.
Export Dept.: The Carpenter Steel Co., Port Washington, N.Y. "CARSTEELCO"

Valuable Tubing Data Book

The Carpenter Stainless Tubing Data Book contains over 90 pages of useful information. If you would like a copy, just drop us a note on your company letterhead.

more than corrosion resistance

Carpenter
STAINLESS TUBING & PIPE

← Analysis → ← Tolerance → ← Finish →

- guaranteed on every shipment

Benchmarks

250,000 companies spent 26 million dollars for paper matchbooks in 1952.

One half ot the freight revenue of the Maine Central Railroad came from the pulp and paper industry in 1952.

The per capita consumption of steel in the United States in 1952 was 1483 lb. a gain of 246 lb. per person since 1940.

There were 1232 paper and board machines in the United States in 1899 and 1708 in 1947. The capacity increase was from 2,782,000 tons in 1899 to 22,873,557 tons in 1947.

Advertising revenue paid to the ten principal advertising media in 1952 was as follows:

Life	—$96,897,749	NBC-Radio	—$47,927,115
NBC-TV	— 83,242,573	ABC-Radio	— 35,023,033
Saturday Evening Post	— 75,331,623	*Time*	— 32,664,222
		This Week	— 22,744,447
CBS-TV	— 69,058,548	*Better Homes & Gardens*	— 21,981,648
CBS-Radio	— 59,511,209		

Western Michigan

Ernest E. Ludwig, Vice-president of Bermingham & Prosser, Kalamazoo, Mich., is the new chairman of the advisory committee at Western Michigan College, succeeding Frederick B. Curtinius. F. C. Goodwill, St. Regis Paper Co., is vice-chairman.

Rayonier

Ralph V. Zepp has joined the Rayonier, Inc., organization at Jesup, Ga., as Assistant Resident Engineer. Michael A. Brown, Jr., has been appointed Sales Manager of Rayonier in New York City.

Rayonier Foundation has been established to provide charitable and educational contributions. The Foundation plans to establish fellowships and scholarships at universities, particularly those located in the Pacific Northwest.

Finland

Pulp, Newsprint, Paper, and Board

According to a preliminary estimate Finnish cellulose shipments in 1952 will total approximately 750,000 tons, sulphite cellulose accounting for two thirds and sulphate cellulose for one third of this total. Pronounced swings have occurred. In July, for instance, the export volume was only 26,000 tons whereas exports totaled 80,000 tons in November. On the other hand, over a fourth of the entire shipment for 1952 was sold in September-October. In 1951 cellulose exports amounted to 982,000 tons and the comparable figures for 1950 and 1949 were 897,000 and 760,000, respectively.

The repercussions of England's commercial policy in 1952 have been felt in the cellulose markets also. Deliveries to England have been slowed down, the tight currency policy, the decrease in paper consumption, and the large stocks accumulated earlier by English factories being the main factors. Even in the last few months consumption of paper in England has not increased in the same proportion as in most other countries. However, the fear of a severe Winter has led English paper mills and some mills of continental Europe, already operating with rather diminished supplies, to make minor purchases for immediate delivery. Demand has also grown in the United States. China is among Finland's new cellulose buyers.

The fact that American and Scandinavian price levels have approached each other has contributed to stabilizing the situation. However, price development has been more favorable from the seller's point of view in the United States than in Great Britain.

The marketing position of mechanical pulp has improved with the contraction of output in all the Northern Countries. The continued shortage of water power suffered by Canada on account of drought has contributed to this development. Finnish exports of mechanical pulp in 1952 will probably be a shade below 150,000 tons, against shipments in 1951, 1950 and 1949 of 210,000, 177,000, and 160,000, respectively.

Newsprint shipments are estimated to exceed 400,000 tons in 1952. In 1951 the corresponding figure was 382,000 tons and the 1950 and 1949 totals were 379,000 and 348,000 tons, respectively. Sales for 1953 amount at this moment to about half the output. English newsprint buyers have recently announced that they will reduce their purchases from the Northern Countries by 50%. Finland's newsprint exports to England in the years 1949–1952 were 34,400, 67,900, 63,000, and 73,100 tons, respectively. England will make good this diminution in her purchases partly by buying from Canada and partly by increasing her own production, which on the other hand will strengthen the market for mechanical pulp. The Soviet Union and China will be among the buyers of Finnish newsprint in 1953.

1952 exports of other papers than newsprint will amount to about 150,000 tons. The comparable export figure for 1951 was 170,000 tons, for 1950 127,000 and for 1949 106,000 tons. Board and kraftliner exports in 1952 will probably rise to 84,000 tons. In 1951, 1950, and 1949 the corresponding figures were 140,000, 88,500 and 61,000 tons. The reduction in the export of paper and board products caused by the general recession amounts to about 30%.

Sulphite

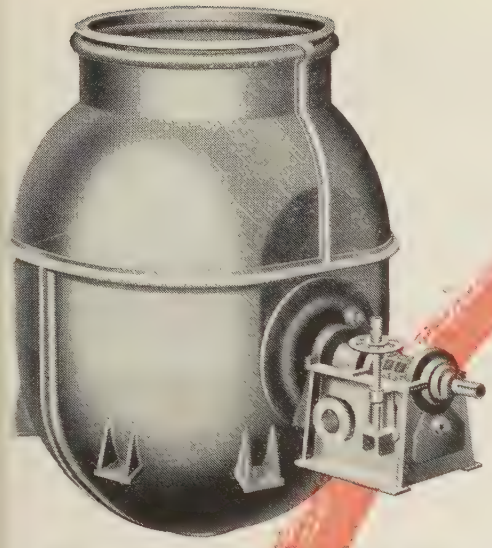
Finland's peak year in sulphite pulp production was 1937, with 1,043,000 tons produced. Of this total 84,000 tons was dissolving pulp, 240,000 bleached sulphite for papermaking, and 720,000 tons unbleached sulphite. Exports, too, reached an all-time high the same year. The quantities exported were 51,500 tons of dissolving pulp, 161,000 tons of other bleached sulphite, and unbleached 470,000 tons. In 1951 output and exports were as follows: 81,000/70,000 tons of dissolving pulp, 191,000/110,000 tons of bleached sulphite for manufacturing paper, and 549,000/410,000 tons of unbleached sulphite; in all, 821,000/590,000 tons. The corresponding figures for the first 11 months of the current year were 75,500/77,000 tons of dissolving pulp, 85,000/86,000 tons of bleached sulphite for papermaking, and 340,000/295,000 tons of unbleached sulphite.

The largest buyers in 1951 were England, which took 222,000 tons, of this 187,000 tons were unbleached, 29,000 tons bleached for papermaking, and 6000 tons dissolving pulp; the U.S.A.: 72,000 tons of sulphite, of which 43,000 tons was unbleached and 29,000 tons bleached paper pulp; France: 65,000 tons, of which 41,000 tons was unbleached, 18,000 tons bleached for papermaking and 6000 tons dissolving pulp; Argentina: 31,000 tons; Italy: 27,000 tons, of which 12,000 tons was rayon pulp; Poland: 21,000 tons, of which 14,000 tons was rayon pulp; and Brazil: 21,000 tons.

Sulphite sales in Finland in 1951 included 9000 tons of dissolving pulp, 6000 tons of other bleached, and 12,000 tons of unbleached sulphite. In 1951 mills themselves used 205,000 tons for further processing of which bleached paper pulp accounted for 62,000 tons and unbleached for 143,000 tons.

Sulphite pulp was manufactured in 1951 by:

A. Ahlström Osakeyhtiö	59,000 tons
Aug. Eklöf Aktiebolag	31,000 tons
Aktiebolaget J. W. Enqvist Osakeyhtiö	31,000 tons
Enso-Gutzeit Osakeyhtiö, Tainionkoski	27,000 tons
Haarlan Selluloosayhtiö	18,000 tons
Jakobstads Cellulosa Aktiebolag—Pietarsaaren Selluloosa Osakeyhtiö	38,000 tons
Kajaani Oy	72,000 tons
Aktiebolaget Kaukas Fabrik	60,000 tons
Aktiebolaget Kemi Osakeyhtiö	47,000 tons
Kymin Osakeyhtiö-Kymmene Aktiebolag	
Kymmene	53,000 tons
Voikka	47,000 tons
Nokia Osakeyhtiö—Nokia Aktiebolag	32,000 tons
Rauma-Repola Oy	62,000 tons



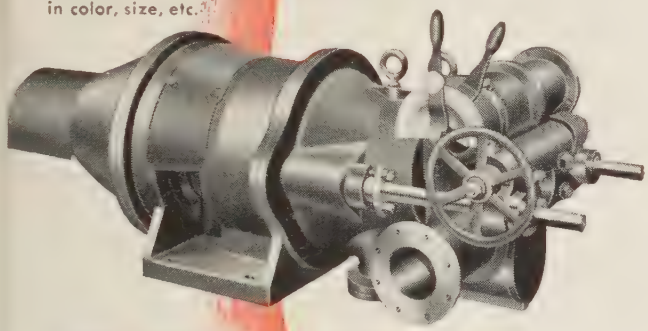
Morden-ize

YOUR STOCK PREPARATION

WITH Morden { SLUSH-MAKERS / STOCK-MAKERS / STUFF-MAKERS

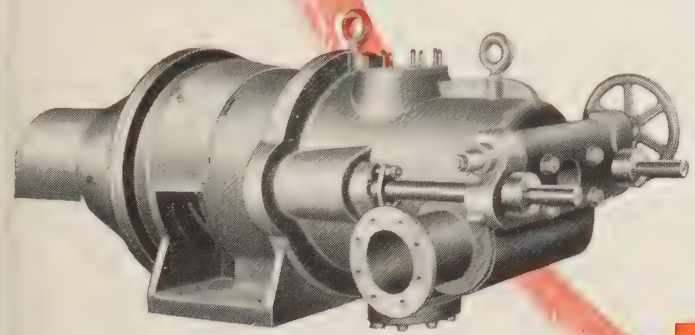
MORDEN "SLUSH-MAKER" FOR PULPING

The "Slush-Maker's" side-mounted rotor quickly and efficiently slushes a full charge of pulp, broke or waste paper, either batch or continuous. The rotor's combination pumping, shredding and brushing blades continually direct the charge at right angles against the attritioning ring, where a controlled bar-to-bar brushing completely clears all flakes and bundles, even high wet strength, without damage to the fibers. The "Slush-Maker's" positive-flow circulation quickly and thoroughly mixes and also brushes in color, size, etc.



MORDEN "STOCK-MAKER" FOR BEATING

The "Stock-Maker" with its 360° bed plate gives the maximum of brushing, fibrillating, beating or hydrating treatment with the minimum of cutting. The "Stock-Maker" operates on a continuous flow basis from chest to chest or chest to stuff box. The reverse-flow, sealed pressure treatment of one "Stock-Maker" will duplicate or improve upon the stock treatment of two or three conventional beaters and yet requires only one third the space of one beater.



MORDEN "STUFF-MAKER" FOR JORDANING

The "Stuff-Maker" utilizes the "Stock-Maker's" well proven construction features but provides a "jordan-type" flow, for shortening or cutting the stuff when required.

Experience with nearly 700 Morden Machines in 175 mills on all types of pulp and grades of paper proves that:

These three Morden Machines are especially designed, each to excel in one of the three phases of stock preparation—pulping, beating or jordaning.

Each of these Morden Machines is engineered for the utmost in efficiency, simplicity, versatility and economy of operation.

These Morden Machines are designed to fit readily into all types of stock preparation systems and can be used together or in combination with existing equipment to give efficiently the various treatments required for developing the most in each furnish.

Let us know of your interest, and we will gladly provide detailed information on how to advantageously Morden-ize your stock preparation system.

MORDEN
STOCK PREPARATION EQUIPMENT
MACHINES COMPANY

Corbett Building, Portland, Oregon.

W. Rosenlew & Co Ab	17,000 tons
G. A. Serlachius Oy	39,000 tons
Osakeyhtiö Toppila	36,000 tons
Veitsiluoto Osakeyhtiö	55,000 tons
Wärtsilä-Cellulosa Ab	40,000 tons
Yhtyneet Paperitehtaat Osakeyhtiö	
Jämsänkoski	28,000 tons
Valkeakoski	29,000 tons
Total	821,000 tons

The production of sulphite alcohol was 27,000 tons in 1951.

The capacity increase under construction in the sulphite industry is approximately 75,000 tons. Capacity increase is also allowed for in the building projects of the forest industry, one tenth of which can be financed from the loans granted by the International Bank for Reconstruction and Development. However, as the papermaking capacity will likewise grow there will be no increase in the quantities of sulphite available for sale.

East Germany

For the first time exact statistics on paper production in East Germany have become available. On the basis of these statistics gathered by the Federal Government, production of paper in 1952 is stated as 378,500 metric tons, which includes 82,400 tons of newsprint and 142,000 tons of printing and writing paper; carton and board production in 1952 was reported at 195,600 metric tons. Total paper and board production for 1952 was 574,100 metric tons, slightly more than the total paper production in Western Germany in 1948. In that year, total paper and board production in the Soviet Zone was estimated at 300,000 metric tons. Since 1948, production must have increased 90%. Based on goals set forth in the Five-Year Plan, a production capacity increase of 57.3% between 1950 and 1955 is called for.

If one supposes that the 1952 goal was achieved (in the first half of the year it is claimed that paper production reached 98% of the goal set and board 96%) and that about 25% of Germany's prewar (1936) production of paper and board is now located in the Soviet Zone, then it appears as if paper and board production in East Germany has attained about 73% of its prewar production status (574,100 tons in 1952 as against 787,250 tons produced in 1936). (*Das Papier*, January, 1953, translated from the German by APPA.)

Portable Power Chain Saws

"Portable Power Chain Saws," a recently published National Safety Council data sheet, presents a detailed account of the safe method of handling portable gasoline and electric chain saws.

The rapid increase in the use of these saws in logging operations has pointed up the need for a thorough understanding of the hazards involved in their operation. Although there is no indication that the use of the power saws has increased cutting crew accidents, there are hazards peculiar to chain saws that are not present when using hand saws. These hazards include:

(a) Being cut by contact with the chain while it is in motion.
(b) Injuries from starting the gasoline motor.
(c) Inhaling exhaust gas.
(d) Electric shock from electrically operated saws.
(e) Being struck by wood from overhead due to vibration of tree.
(f) Getting sawdust in the eyes especially when holding the tail stock or "stinger" end of the saw above the head.
(g) Injuries due to binding and kicking back at operator.
(h) Burns from contact with hot muffler or cylinder head.
(i) Injuries from falling trees and snags or rolling logs due to inability to hear because of noise of gasoline motor.

The data sheet, D-W 12, tells how to minimize the dangers involved in handling the portable saws. Special attention is given to each of the following subjects: handling and transportation, operation of the saw, undercutting, felling the tree, use of springboards and poles, bucking, one-man saws, care of saws, grounding equipment, gasoline motors, prevention of fires, and protective clothing.

In handling the saws, the importance of stopping the motor whenever a cut is completed is stressed. If the motor is electric, the cable should be disconnected as an added precaution.

The chain should not be started until the saw is in position ready to cut. And the operators should stand at the ends of the saw—never beside it. Operators who keep good body contact with the motor frame at all times will find that they will be pushed rather than struck when the saw binds or kicks.

It is important that undercuts be made properly if the tree is to fall straight and not slab or kick back. Although a wedged shape undercut is sometimes used for trees under 18 in., the usual method is to make nearly horizontal cuts 3 to 8 in. apart, depending on the diameter of the tree, and extending about one third the thickness of the tree. When a big tree is being cut, a stepped undercut is used to keep it from rolling on the stump.

If the tree settles back after the saw has fully entered the cut, it may bind on the chain at the back and may cause the whole machine to kick violently in the direction of the operator. If a tree has a tendency to bind, it must be wedged. Wooden or magnesium wedges should be used since they are lighter to carry and will not damage the cutting chain beyond repair, nor throw steel splinters which might cause eye injuries.

The falling of a tree by a power saw consumes so little time that ample warning should be given to other men before the backcut is started. If a man is in the danger zone when the cut is started, he does not have time to escape to a place of safety.

The data sheet includes a section on the hazards of bucking heavy timber. Since the cut is made much faster with a power saw, the bucker must foresee exactly what is going to happen when the cut is completed.

Every electrically operated chain saw should be grounded. The danger from a machine frame which becomes energized when a man is handling it and standing on wet ground is considerable.

Hard hats always should be worn by fallers and buckers and others working in the woods. Inability to hear falling deadwood because of the exhaust noise makes it especially important that hard hats be worn.

The six-page data sheet, which includes photographs and drawings, was prepared by the Wood Products Section of the National Safety Council. It is available to Council members at 17 cents a copy for 1 to 9 copies. Nonmember prices are double. Write the National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

Management Awards

Certificates of Management Excellence for the year 1952 have been awarded to 11 paper companies by the American Institute of Management, New York. Seven received the award for the third consecutive year: Champion Paper & Fibre Co., Hamilton, Ohio; Crown Zellerbach Corp., San Francisco; Great Northern Paper Co., Boston; Marathon Corp., Rothschild, Wis.; Scott Paper Co., Chester, Pa.; St. Regis Paper Co. and West Virginia Pulp & Paper Co., both of New York. Three received it for the second time: International Cellucotton Products Co., Chicago; Kimberly-Clark Corp., Neenah, Wis., and Northern Paper Mills, Green Bay, Wis. The Brown Co., New York, obtained the award for the first time this year.

According to Jackson Martindell, president of the Institute, a nonprofit foundation devoted to improvement of corporate policies and practices only 330 companies in the United States and Canada, out of the 3000 leading concerns whose methods were studied by the Institute, were found eligible to receive the designation.

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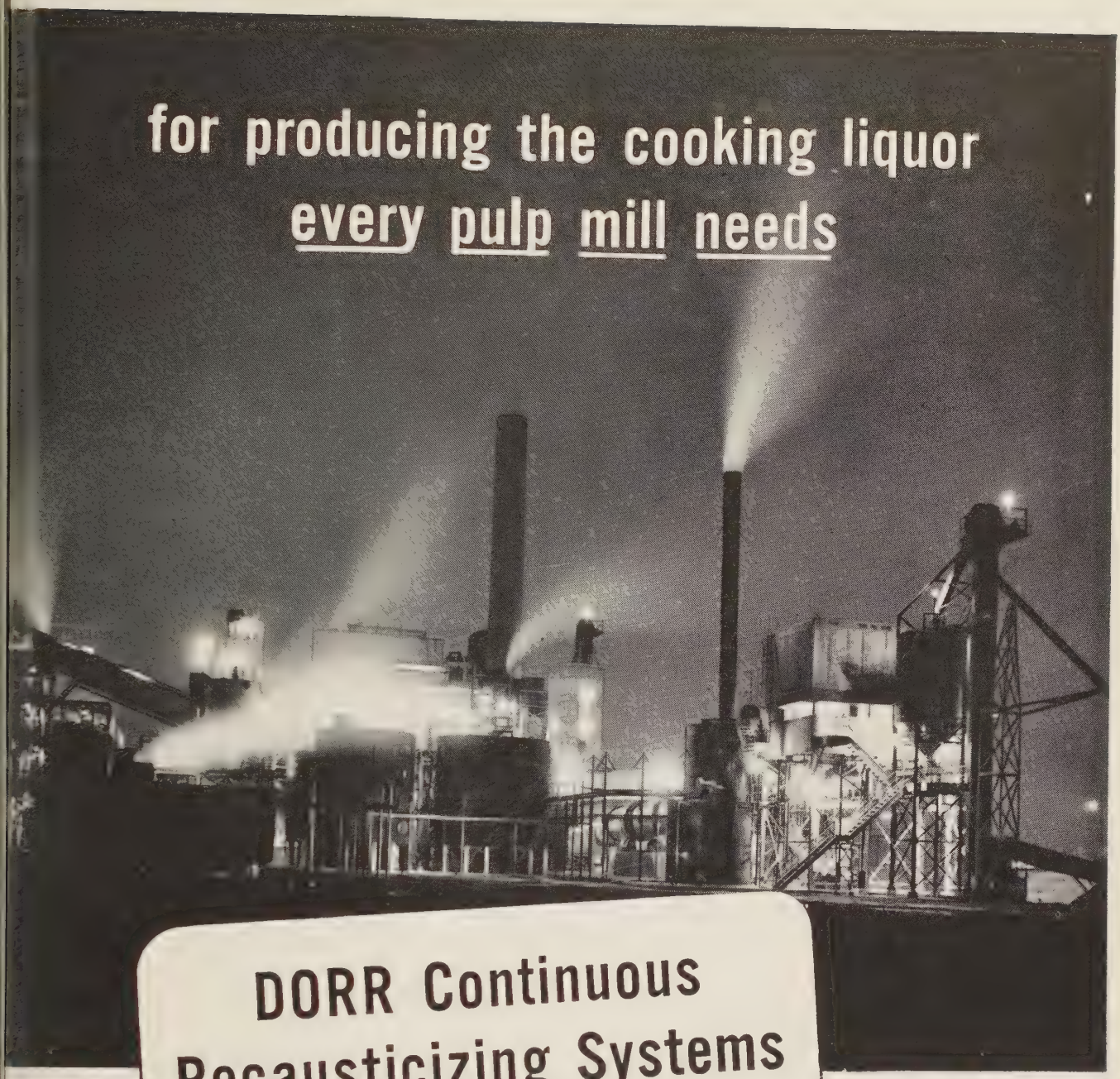

DORR Continuous Recausticizing Systems

First new U. S. source of newsprint in a decade, the Coosa River Newsprint Company at Coosa Pines, Alabama, uses a standard Dorr Continuous Recausticizing System — center of photo — to produce 30,000 cubic feet of white liquor daily. The original survey and recommendations were made by J. E. Sirrine Company of Greensville, S. C., who later provided engineering collaboration to the Kimberly-Clark Corporation in the latter's over-all responsibility for mill construction.

If you would like information about the newest equipment and techniques in continuous recausticizing, drop us a line and ask for a copy of Dorr Bulletin No. 3301.

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Union Bag Scholarships

Applications for the four college scholarships given each year to qualified Chatham County youths by Union Bag & Paper Corp. are now being received by the scholarship selection committee, it was stated recently by management at the local plant.

As outlined under the continuing scholarship program of the company, the grants are for $1000 a year for four years. Three of them will go to sons of Union Bag employees, retired employees, or deceased employees, and one will be awarded to a resident of the county whose parents are not working for the company.

Recipients of the awards may elect to attend any college in the country with a properly approved curriculum in their chosen field. Courses chosen, however, must be limited to engineering, business administration, forestry, science, or other courses which in the opinion of the scholarship committee will fit the applicant for work in industry.

This is the second year that the new scholarship program has been in effect, Union Bag officials point out. Since four of the four-year grants are made each year, by the fourth year 16 young men from Chatham County will be attending college on these scholarships.

Under the terms of the program, young men who receive the grants will be offered work at Union Bag's local plant during their Summer vacations.

It's explained that this requirement has been set up in the plant to further the student's interest by enabling him to earn money to help pay part of his educational expenses and at the same time acquaint him with the workings of large industrial establishments.

Company spokesmen also say that while scholarship winners will be encouraged to begin their careers with Union Bag & Paper Corp. upon graduation, they will be under no obligation to do so.

Chairman of the selection committee, the group which passes final decision on applications received, is J. R. Lientz, head of Union Bag's Pulp and Paper Div. Serving on the committee with him are Dr. Phil B. Narmore, executive dean of the Georgia Institute of Technology; Dr. Alvin B. Biscoe, dean of faculties, University of Georgia; Dr. Robert L. Sumwalt, dean of the school of engineering of the University of South Carolina; and Dr. Robert C. Beaty, dean of men at the University of Florida.

Scholarships will be awarded on the basis of character, leadership, personality, and scholastic standing. Aptitude tests, interviews, and the usual physical examination may be required.

Completed applications must be submitted by April 1, 1953, and application blanks and further information may be received by writing J. R. Lientz, Chairman of Scholarship Committee, Union Bag & Paper Corp., Box 570, Savannah, Ga.

Announcement of the awarding of scholarships will be made some time during the early part of June.

Working with the selection committee, the group of educators who do the actual awarding, is the scholarship committee made up of Union Bag executives. This group conducts preliminary appraisals of applications, works with various colleges and universities, and gathers necessary information so that the actual selection can be speedily accomplished.

This scholarship committee is composed of J. R. Lientz, chairman; M. L. Taylor, manager of the technical division, J. M. MacBrayne, manager of the industrial engineering department; F. W. Kelley, manager of the industrial relations division; and L. W. Ross, personnel analyst of the industrial relations division.

Last year the scholarship awards went to William M. Gruber, Danny B. Kennedy, Robert L. Simerly, and Marvin Earl Ellis, Jr. All are presently attending college, Mr. Gruber at the University of Maryland and the others at Georgia Tech.

Springfield Coated Paper

Louis Schulman, president of the Springfield Coated Paper Corp., has announced the installation of the first of several modern air knife coaters in their Camden, N. J., plant. This new machine represents the latest development in the coating of paper. It operates on an entirely new principle. The color is applied to the paper by a cylinder instead of brushes and a sharp blast of air blows off the excess color. These units are scientifically constructed and may be regulated both for pressure and angle in order to give literally microscopic control of the color coating. This new method permits hitherto unattainable uniformity, more intense color, and smoother finish. In addition, the air knife coater runs at a greatly increased speed and handles a 70-in. wide roll.

Newsprint—1951

In 1951 the United States consumed 60% of all the newsprint produced in the world, but ranked only ninth in the circulation of daily newspapers per 1000 population, according to figures published in the 1952 issue of the United Nations *Statistical Yearbook*. At the same time, Canada accounted for well over one half of the world (excluding the U.S.S.R.) production of newsprint in 1951, the next largest producers being the United States, the United Kingdom, Finland, Sweden, and France.

The *Statistical Yearbook 1952* is the fourth issue of the Yearbook and was prepared by the Statistical Office of the United Nations with the active cooperation of some 100 national statistical offices, UN specialized agencies, and other intergovernmental bodies.

Compared with the prewar peak year, 1937, newsprint output in 1951 was up nearly 40% in Canada and 14% in the United States; it was around the same level in the three Scandinavian countries taken together, but was down 16% in France and by as much as 42% in the United Kingdom. The 1951 newsprint production in Germany and Japan—formerly substantial producers—was also much below prewar. As a result of these developments the 1951 world (ex. U.S.S.R.) production of newsprint was only 10% above the 1937 level.

The principal consumers of newsprint in 1951 were the United States with 5421 thousand metric tons—an increase of 68% over the prewar average 1935–39—followed by the United Kingdom with 608 thousand metric tons or less than half the prewar figure, France with 349 thousand, and Canada with 327 thousand metric tons. In 1950, Western Germany and Australia took 208 and 180 thousand metric tons, respectively. Since prewar, United States consumption has increased by about 2.2 million metric tons, 30% more than the corresponding increase in world (ex. U.S.S.R.) output of newsprint.

Before the war, per capita consumption of newsprint was highest in the United Kingdom (26 kilos), followed closely by the United States (25 kilos), Australia (24 kilos), New Zealand (21 kilos), Canada (15 kilos), Denmark (14 kilos), and Sweden (13 kilos). By 1951 per capita newsprint consumption had risen in the United States to 35 kilos, in Canada to 23 kilos and in Sweden to 19 kilos, while it had dropped slightly in Australia to 22 kilos (1950), in New Zealand to 17 kilos, in the United Kingdom to only 12 kilos, and in Denmark to 11 kilos.

Countries whose newsprint supplies were seriously curtailed apparently have maintained circulation of daily newspapers by drastically curtailing their size. Thus circulation of dailies per 1000 population in 1951 or 1952 was highest in the United Kingdom with 612 copies, followed by Sweden with 490, Australia with 455, Luxembourg with 452, and Norway with 403. The United States with 356 copies ranked ninth. At the other end of the scale, Burma and India had a circulation of 8 copies per 1000 population, Iran 5, Thailand 4, Haiti, 3, Pakistan 2, and Afghanistan 1.

How a Smallpox Epidemic Started the First Mass Production of Paper!

In A. D. 735 a smallpox epidemic struck Japan. To drive out the "evil spirits" believed to have been the cause of the disease, Empress Shotoku sanctioned the printing of a million paper prayers. Each prayer was to be enshrined within an ornate wooden pagoda eight inches high and approximately four inches in diameter at the base. Requiring six years to complete, the project led to the first large-scale production of paper and to the world's first text printing upon sheets of paper. Just as this event contributed to the progress of paper-making, A. E. Staley Manufacturing Company promotes progress in modern papermaking by supplying high-grade raw materials to the nation's leading mills. Contact your supplier or write direct for details.

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Neenah Mill of Kimberly-Clark

There are many thousands of people on the North American continent today who know the location of a small, prosperous city named "Neenah." The chances are they would know a good deal less if it hadn't been for Kimberly-Clark Corp., and its "Neenah mill."

Today's Neenah mill is two-in-one. It is Badger-Globe and Lakeview welded into one operating unit for creped wadding production.

Thirty carloads of product go out by rail from Neenah mill each day. A month's production would fill a train stretching the 6 miles from Neenah to Appleton, a train loaded with Kotex, Kleenex, Fibs, Delsey, Kimwipes, Kimpak, Kimsul, and Sanek.

Its creped wadding machines consume 260 tons of pulp a day. It takes 11 million gal. of water to supply the mill needs for 24 hr.—or enough to supply the municipal needs of seven cities the size of Neenah. The boilers at the Lakeview division of the mill (Badger-Globe buys its steam) eat up 35,000 tons of coal a year.

These are big figures, indicating a big operation. And one of the biggest of the headline features of this mill is its cleanliness and its sanitation program. One measure is the cost of the program—which runs well up into the six-figure category in a year's time. Another measure is that some 2000 gal. of paint each year are used to keep the mill in top condition.

Its cafeteria business compares with a big city restaurant—3000 servings daily are handled by its personnel. It could be a "Koffee Klatscher's" paradise: 2500 cups of coffee are served daily. It is operated on a "nonprofit" basis for the benefit of employees in the mill—which actually means it operates in the red.

Its new six-story warehouse is the tallest building in Neenah and the space in it would be sufficient for six football fields.

The monthly payroll of Neenah mill approximates $570,000. There are 1831 people employed in the mill, with 1311 at Lakeview and 520 at Badger-Globe. Neenah provides 43% of the employees, Appleton and Menasha 23%, Oshkosh 7%, Kimberly 1%, and other communities 3%.

And Mill Manager F. H. "Sprig" Werling points out, "Its modern mechanization is one of its outstanding features. While I was not Mill Manager then, or in the years from 1934 to 1941, I believe historically that the 7-yr. span prior to the war marked its most significant period. It was then that Lakeview was transformed from a two-paper machine mill to a four-creped wadding and one-paper machine mill and Badger-Globe from a three-small machine mill to a four-creped wadding machine unit. (The Lakeview paper machine has since been replaced with a fifth creped wadding machine.)"

Neenah mill's history is unusual. The name Neenah mill is older than Kimberly-Clark itself but as much a part of the historical pattern as the corporation name.

Turn the pages of Neenah history back to 1865 and it will reveal that the Neenah (Red) mill was built on the site of a government sawmill by a group of six men. It was built to manufacture wrapping paper and newsprint. Among those six men was Moses Hooper, who later became counsel for Kimberly-Clark and was associated with the corporation for more than 50 yr. When Kimberly-Clark observed its 50th anniversary in 1922, Hooper wrote, "I have often wondered how variant from what my life has been it would have been if I had never had the confidence of that (K-C) company. I count myself most fortunate in having retained that confidence, through success and defeat, so long."

Hooper continued as legal adviser until his death in 1932 at the age of 92. (His son, too, was to become a counsel for the company and today his grandson represents the third generation in Kimberly-Clark for he is in the financial department of the corporation.)

Colonel H. P. Haynes was Manager of that Neenah (Red) mill and he came to Kimberly-Clark in 1872, founding year of the paper firm that bears the name of two of the original four founders.

John Alfred Kimberly, Charles Clark, Havilah Babcock and Frank Shattuck were members of the partner quartet that built the first Kimberly-Clark mill . . . the Globe . . . on the site now occupied by the east extension of the Badger-Globe division of today's Neenah mill.

This first Kimberly-Clark mill, equipped with one 72-in. machine produced 2 tons of ragstock newsprint on the start-up day, Oct. 22, 1872.

Two years later, 1874, the partners purchased the old Neenah (Red) mill from the owners and it became a part of Kimberly-Clark, with a name that was to remain a part of the corporation through its 80-yr. history.

An addition to the Globe in 1876 made this first Kimberly-Clark plant the largest in the city. It was 210 ft. long and 88 ft. wide. The mill was growing, and two years later, a four-drinier machine, together with what was then termed "modern appliances," was installed to increase capacity.

About 6 yr. later, the property just east of the Globe was purchased. It had been the Reliance Flour mill, operating under the name of J. R. Kimberly and Co., and the Smith and Proctor flour mill. The Smith mill was razed, and on the site was built a mill with one 8-ton capacity newsprint machine. This new unit was known as the Badger mill. The other newly purchased mill was not torn down and still stands today . . . the familiar "stone mill" whose construction dates back to 1868.

The old Neenah (Red) mill became part of the past in 1885 when it was razed. On that site was built a new Kimberly-Clark Neenah mill. The building was largely of masonry and its stone foundations are still intact today, many of them after being exposed for over 60 yr. to time, weather, and the water that came through the raceways and flumes. (This mill, completely transformed, is today's research and development laboratory.)

The new Neenah mill was equipped with two fourdrinier machines, one 60-in., one 80-in. They were to manufacture book paper. (The 60-in. machine was shut down about 1920 except for experimental runs.)

Neenah mill has a product history that reads like the pattern for today.

The Globe mill (1872) made ragstock newsprint.

The new Neenah mill (1885) made book paper.

The Globe mill was converted to make fancy wrapping papers (1892).

Badger mill (1878) was converted to make book paper lines.

Globe mill started manufacture of toilet paper in 1914.

Globe mill started making cellucotton in 1915.

Neenah mill added a second machine to make absorbent wadding.

When the first World War ended, the facilities developed for absorbent dressings were adapted to the making of Kotex.

The pads then were marketed by the gross and if the inventory of finished stock amounted to two cars, everyone worried. Speaking in the same language today, Neenah mill's 1-day production is 20 cars of pads.

During World War I, Kimberly-Clark, with the aid of government scientists had developed a material for use as a gas mask filter for tear and sneezing gases. Work had gone far enough on this so that a third creped wadding machine had been installed to manufacture it when the war ended.

After commercial production of Kotex was under way, this product was given further study and Kleenex was evolved and production began on a commercial scale in 1924.

Within 2 yr. other products began to spring from the creped wadding beginnings.

Embossed wadding used in fancy packaging was developed.

Kimpak, too, had its beginning about this time.

Badger-Globe produced the first Kotex sanitary belt in 1929.

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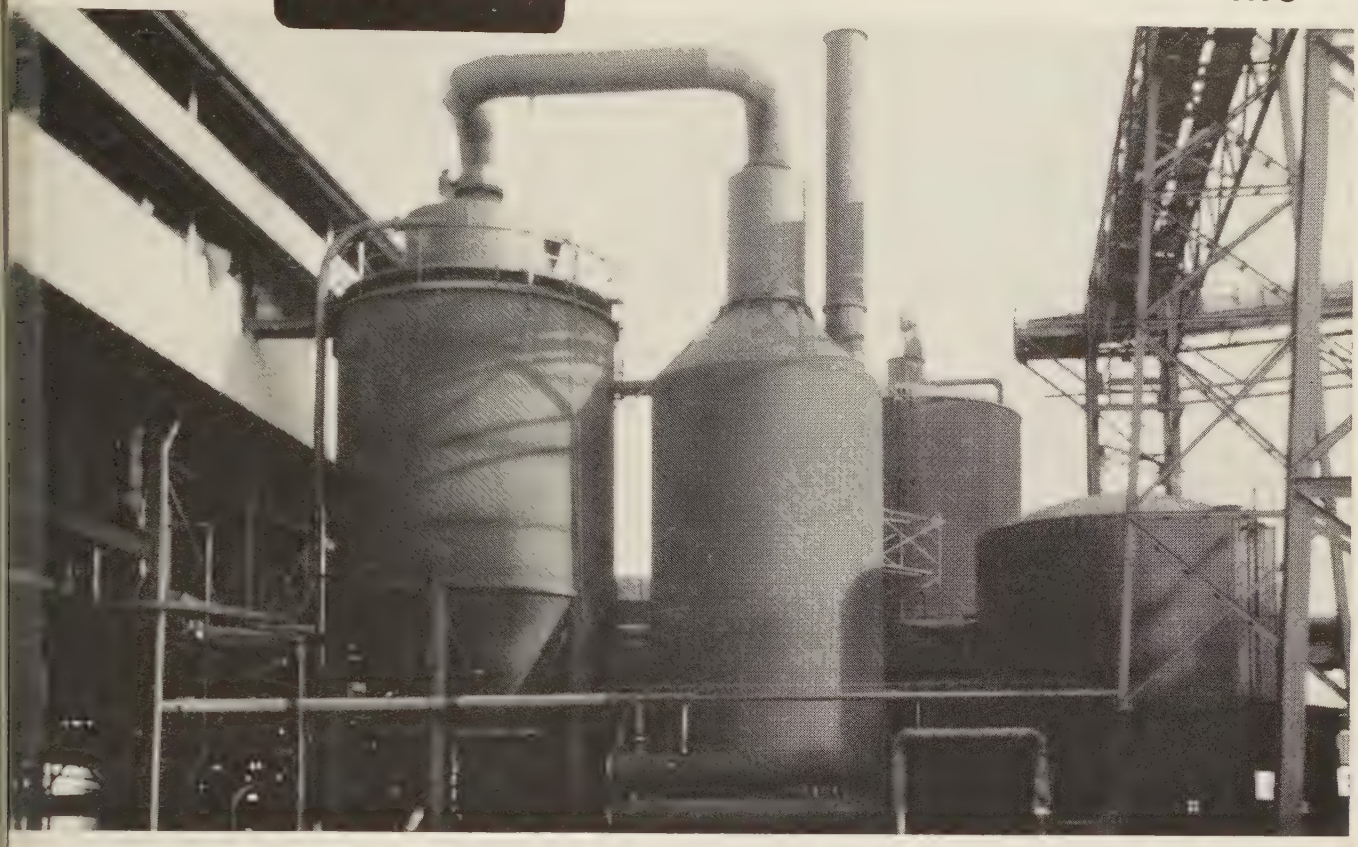

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Fibs were added to the sanitary products line in 1935. Kimflex was a member of the product family also for about 10 yr. This material was a substitute for some leather parts in the manufacture of shoes and other articles. Commercial operations began in 1933 in the then Neenah mill. With the coming of the second World War, the supply of latex was cut off and Kimflex became a war casualty.

From the mid-twenties on, Badger-Globe had been manufacturing an insulation panel of Kimpak treated for moisture resistance. In 1930, a blanket-type home insulation was made but it was dropped a year later. Further experimentation with the insulation idea brought about the Kimsul business.

With World War II, Badger-Globe was called upon to do its share for the armed services. Kimsul insulation went into Quonset huts going overseas, to provide protection against the heat of the tropics and the cold of the Artic. About 200 million sq. ft. of Kimsul was so used.

Badger-Globe was a ripe 57 when the other half of the Neenah mill of today—Lakeview—joined the Kimberly-Clark mill family.

It was purchased in 1929 from Fraser Co., Ltd., which had bought it from Sears, Roebuck, and Co. (which had been using it to make catalog paper). The mill was located on N. Lake St. outside the city limits in the town of Menasha.

Three additions to the original building were put up and the mill started production in 1930 with two machines. One produced a sheet trimmed at 105 in. It was equipped with two cylinder molds, color droppers, color sprays and blend equipment. The other machine was a standard fourdrinier type. The finishing room had its equipment, too. Principal product was school papers but the mill soon entered the wallpaper converting operations. This, too, was of short duration.

In 1935, the reconversions and changes that started Lakeview on its sanitary creped wadding career were started. A year later, a new four-story addition was built to house Kleenex converting equipment. The no. 3 creped wadding machine was installed. Two major additions to the building were made shortly to house the new machines, no. 4 and 5. A four-story Kotex building was erected.

The paper mill continued to operate with no. 2 machine producing cover papers and large quantities of raw stock for Atlas mill converting operations. About 1938, the first work on a new product, Delsey toilet tissue, started in the Kleenex department. As new equipment was added, the Delsey department came into its own unit by 1940.

Lakeview had its share of war work too in the 1940's. More than 555,000 reams of mimeograph paper went out to the armed services at the various fronts. Lakeview's machine shop started a project of machine parts, jigs, and fixtures for supply armaments. Over a 3-yr. period, items machined included hydraulic cylinders for bomber landing gear, rammer racks for guns, dies for shell cases, submarine and ship parts, gages, dies, and fixtures.

The name, Neenah mill, came back into its own late in 1949, when Lakeview and Badger-Globe became part of a single mill organization to be known as Neenah mill.

Neenah and Menasha

Just as Neenah mill is two-in-one, so is the community of Neenah and Menasha. The Twin Cities, divided only by a boulevard, are separate units, proud, energetic, ambitious but working together jointly on many projects for the betterment of the people and life in both communities.

Neenah came into existence in 1843 when Harrison Reed purchased the area known then as Winnebago Rapids. Curtis Reed might be called the founder of Menasha as he purchased real estate in 1846 to found a rival town. Though the friendly rivalry has continued through the years, on many broader issues the communities work cooperatively.

Harvey Jones, who also had part in the early development of Neenah, erected the first mill built on water power when he constructed a sawmill on the site where now stands the Neenah Paper Co. mill.

Neenah was incorporated as a city in 1873 and its first mayor was elected in April of that year. Menasha was incorporated in 1874 and had its first mayoralty election in the same year.

Five years later, Neenah had a population of 4 to 5 thousand and was reported as having "the best financial standing and commercial record of any place in the state." Its newspaper editor then was writing, "We believe, however, that the growth will be limited, as is the water power privileges, and predict that another 20 yr. will find our city noted for its wealth, its beautiful location . . . rather than for its increased growth or added industries."

Paralleling the growth and development of Neenah mill was that of the twin communities. Other industries, predominately paper, helped them to progress.

Today, Neenah and Manasha have well over 12,000 people residing in each community. Neenah has 25 industries, Menasah 24. The state estimated value of Neenah is put at $56,542,570, and Menasha $52,944,300.

Both cities have modern school buildings, churches, full time recreational programs, and libraries. Both communities have benefited from the philanthropic and community minded industrialists who founded and built their industries.

St. Regis

In April, 1952, the new no. 4 kraft paper machine in Pensacola went into regular production, rounding out the expansion of this mill's capacity to 265,000 tons of kraft paper and board per year. The pulp mill at Pensacola was also expanded in support of this enlarged paper production, by the addition of seven new digesters and other pulp mill equipment.

The new paper machine produces paper with a maximum trimmed width of 210 in. and is designed for speeds up to 2400 f.p.m. It has several unusual design features which are expected to maintain high quality and uniformity in the product, and to provide highly efficient operation. Pensacola's no. 3 and no. 4 machines are among the most modern paper machines in the United States.

The buildings for the expansion of the multiwall bag plant at Pensacola, begun late in 1951, are substantially completed as this report goes to press.

The additional floor space permits the rearrangement of bag-making machinery for more efficient operation, addition of new machines, and absorption of considerable equipment from other bag plants. At its completion, production capacity of this plant will be increased by 50%, making this one of the largest multiwall bag plants in the United States.

An important adjunct of this expansion is the new warehouse for kraft paper storage. Paper in practically all sizes and weights regularly used will be kept available for the bag plant. This will involve fewer change-overs on the paper machines, and enable the bag plant to improve its service to customers.

The administration building for the entire Pensacola operation is nearing completion. This will house the executive and general offices, and the kraft paper and bag research laboratory.

The new kraft pulp, paper, and board mill at Jacksonville, Fla., was practically completed during the year and began shipping paper early in January, 1953. Its production is intended principally for paper and board customers.

To support the Jacksonville mill's production, St. Regis has entered into long-term timber purchase contracts, and now controls the timber on approximately 310,000 acres in northeastern Florida and southeastern Georgia. Most of these holdings are within 100 miles of the mill. This includes two important contracts concluded during the year. The

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pulpwood requirements are amply protected by the annual growth on these lands.

In the course of the year, improvements in the pulp mill were completed which, among other things, provided additional capacity permitting the mill to satisfy the full requirements of the kraft paper machine, and to maintain the amount of bleached sulphate pulp available to be sold in the market.

The new multiwall bag plant was completed and began making bags in May, taking over production from the leased bag plant at Seattle which was closed. The Tacoma plant provides necessary additional capacity. It also creates a kraft center on the Pacific Coast similar to the company's larger operation at Pensacola, where a complete manufacturing cycle takes place on one site, starting with pulpwood logs or chips and ending with heavy-duty bags. This has decided advantages from the standpoint of both operating efficiency and better servicing of customers' needs.

Completion of the new construction at Pensacola and Jacksonville, and the enlargement of the pulp mill at Tacoma conclude the present phase of expansion in the company's integrated kraft paper and multiwall bag manufacturing capacity in the South and on the Pacific Coast. With these greater facilities now in full operation, the company's total manufacturing capacity for kraft paper and board is 560,000 tons per year.

In further development of its business in kraft products, the company contemplates construction of an enlarged bleach plant at Pensacola in the near future which will make possible a much larger output of bleached kraft paper and board, a market in which St. Regis has taken an important place.

On Dec. 20, 1952, the Howland mill which had been acquired for temporary operation 2 yr. ago was shut down permanently. This mill will be dismantled.

In 1950, to cover a shortage of market pulp, accompanied by abnormally high prices, particularly from overseas producers, St. Regis purchased and rehabilitated the Howland mill at West Enfield, Me., having a capacity of 30,000 tons of kraft pulp per year. This measure was taken in order to tide over an emergency condition.

As reported to the stockholders last year, St. Regis has progressed considerably in the use of chips made from clean waste wood, of the desirable pulping species, coming out of the operations of sawmills, sash and door factories, and plywood mills. These chips, properly produced, are equal in quality to chips made from pulpwood, logs, and are purchased under long-term contracts from the wood-using industries in the immediate vicinity of the company's mills. This comparatively recent practice conserves growing timber. Moreover, to the extent that it can be developed on a permanent basis, it relieves the company of the necessity for making additional capital investment in timberlands and cutting rights, for which prices have been steadily rising. It also benefits the saw mills and other woodworking industries substantially by giving them a steady and profitable market for material that they could not use, and formerly burned.

St. Regis first adopted the use of such chips at its Tacoma kraft mill. With the success of this material, Tacoma has increased the usage, to the point where it now represents an important portion of the fiber consumption.

The company has also been interested in extending the use of sawmill chips to its mills in the South. The problems are somewhat different and the program has been under close study for some time. During 1952, St. Regis made a major step forward in reaching an agreement with one of the larger sawmill companies in southern Alabama, located within a reasonable distance of the Pensacola mill, to supply this mill with chips from barked sawmill slabs which would otherwise be burned. This lumber company has just installed barking and chipping equipment, and began delivering chips to the Pensacola mill early in 1953. This marks the first adoption in the Southeast of an improved usage of wood which will aid in preserving the forests.

The Engineering and Machine Div.'s plant for the manufacture of bag-filling and bag-making machines has been situated at Oswego, N. Y., for a number of years. The building having been sold to Marathon Corp., St. Regis decided to relocate the operation in East Providence, R. I., due to the good supply of skilled labor in that area for precision metal-working industries, and other favorable factors. A new plant is now being built for lease to St. Regis on a long-term basis. Operations at the new location are planned to be under way by July 1.

Early in 1952, St. Regis disposed of a minority interest in the subsidiary company which has operated a bag manufacturing plant at Ponce, Puerto Rico, since 1949. St. Regis retains a 60% interest in the common stock.

Considerable progress was made during the year by major oil companies in exploration and drilling on oil properties in southern Alabama and northwestern Florida, a region in which the company has large timberland holdings. One important field was discovered and is presently under development to definite its productive limits.

The commercial discovery of oil in the Pollard Field, Escambia County, Ala., by Humble Oil & Refining Co., in January 1952, resulted in great leasing activity by oil companies through this whole territory, including peninsular Florida. Over 16,500,000 acres of land were leased and are now held for prospecting, exploration, and development by major oil interests. There are 30 prospecting crews and 12 exploratory deep drilling units now actively operating. In the Pollard Field and its immediate vicinity, 11 oil companies have leased land. Three of these companies, following exploration and drilling, have realized commercial production. At this writing, the Pollard Field has 28 producing oil wells and two development drilling units operating.

On a tract of 840 acres under mineral lease to Stanolind Oil & Gas Co., with respect to which St. Regis owns an undivided one-quarter interest in the minerals, there are four producing oil wells, and three drilling locations. Stanolind has plans for more well locations on this tract, depending on the results obtained by its present development drilling.

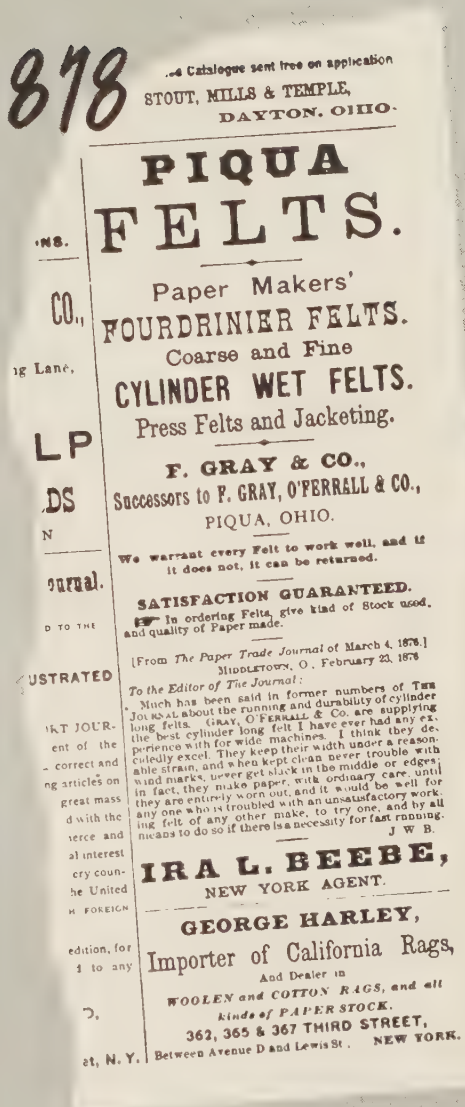
On a tract of 7935 acres under mineral lease to Sun Oil Co., seismograph and core drill crews are now engaged in exploration. St. Regis owns an undivided one-half interest in the minerals in this tract.

Within recent weeks, following a report prepared by the geologist whom it retains, St. Regis Paper Co., entered into a joint operating agreement with Gulf Refining Co., Commonwealth Oil Co., and Florida Oil and Gas Co. This agreement provides for the drilling of an initial well, and additional wells on consent of the parties, on a tract of approximately 1700 acres in Escambia County, Ala., within 3 miles of the present producing area. Drilling of the initial well is scheduled to begin shortly.

In the Florida Panhandle and southern Alabama, within a radius of about 40 miles from the Pollard Field, St. Regis owns or controls nearly 300,000 acres of timberlands to supply pulpwood to that mill. On 171,000 acres of these lands, the company owns an undivided one-half interest in the mineral rights, the other undivided one-half interest being owned by Florida Oil and Gas Co., a Florida corporation. On 42,000 acres of these lands, the company owns all the mineral rights. On the remaining 87,000 acres, St. Regis' mineral rights vary up to one-half interest, the remaining mineral interests being owned by various parties.

No arrangements have been concluded as yet for exploration and development of the oil possibilities on these timberlands, except as referred to above, but negotiations are in progress with several major oil companies. St. Regis is continuing to study the oil developments closely in this entire area, with technical consultation and advice.

an echo from 1878



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[From *The Paper Trade Journal* of March 4, 1878.]
MIDDLETOWN, O., February 23, 1878

To the Editor of The Journal:

Much has been said in former numbers of THE JOURNAL about the running and durability of cylinder long felts. GRAY, O'FERRALL & Co. are supplying the best cylinder long felt I have ever had any experience with for wide machines. I think they decidedly excel. They keep their width under a reasonable strain, and when kept clean never trouble with wind marks, never get slack in the middle or edges; in fact, they make paper with ordinary care until they are entirely worn out, and it would be well for any one who is troubled with an unsatisfactory working felt of any other make, to try one, and by all means to do so if there is a necessity for fast running.

J. W. B.

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Just as a paper maker of long ago praised the quality of Orr Felts in the above old time ad, so do today's makers of paper hold Orr Felts in high esteem.

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Indeed, Orr has long been recognized as a leader—witness the recent development of Orr-Chem felts and An-Bac felts to assure better felt performance, longer felt life.

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Hinde & Dauch

Mass production as we know it in America today would be impossible without improved packaging, shipping, and distribution methods, according to the American Institute of Management, New York. "The corrugated box," this organization points out, "is the touchstone of the packaging industry. It has saved manufacturers and consumers incalculable expense by speeding up handling and packing. Almost all the food, clothing, and packaged products consumed in this country are shipped in such boxes."

Reliance on such containers has grown steadily through the years since 1892, when corrugated boxes were first accepted by the railway express companies, an Institute study reveals. This initial inroad on the wooden box and barrel was achieved by a company which is still a leader in the corrugated box field—The Hinde & Dauch Paper Co., of Sandusky, Ohio, which had been formed as a partnership in 1888, and whose first corrugated package was a protective tube for lamp chimneys, glass jars, and bottles. The first paper company to develop the corrugated box, it is now the sixth largest manufacturer of corrugated shipping boxes, competing with 16 companies of relative importance.

These facts are brought out in a management audit of Hinde & Dauch, conducted by the Institute and distributed in report form to its 10,000 members. Special emphasis is given in the study to the parts which research and development, production efficiency, sales vigor, fiscal policies, and fairness to stockholders have played in the company's growth. "While some less conservative companies in the industry have grown more rapidly," the AIM report declares, "no other company in the industry has made a more worth-while contribution to the national economy. It manufactures hundreds of styles and sizes of corrugated shipping boxes, custom built for practically every type of product from heavy automobile parts to delicate watches."

In 1902, the Institute reports, Hinde & Dauch established its Package Laboratory, in which the following innovations were developed: the first corrugated box for shipping canned foods, in 1917; the first corrugated box for shipping paint, 1924; corrugated "Prepak" for retail merchandising, 1929; application of color to corrugated board, 1933; combination shipping-display box, 1934, and, in 1951, the two-piece "Hevi-Duty" box for shipping nails nuts, bolts, etc.

"One of the most modern and completely equipped research laboratories has recently been installed in the Sandusky plant of this company," the report continues. "All Hinde & Dauch customers are invited to use this laboratory, as well as those in its other plants, without charge for any type of test that may enable them to ship their products more efficiently and safely.

"In addition to its laboratories, Hinde & Dauch participates in, and helps to finance, research exclusively for the paperboard industry. The company's consistently active interest in research and development is reflected in the size of its annual appropriations earmarked for such purposes."

On the production front, the management audit points out, the company's progress is dramatized by the fact that more than a third of its 2865 employees have been with the firm over 15 yr., and more than 500 over 25 yr. All production jobs are evaluated by joint committees representing both management and labor. Promotions are done on the job sequence basis. The company has had a retirement plan since 1947.

In the field of sales Hinde & Dauch has expedited growth through decentralization. The company has three main sales divisions—Eastern, Central, and Sandusky—which operate from 40 sales offices throughout the United States. Special mention is given in the AIM report to the company's sales training program and to the coordination of sales and technical divisions at all levels.

Under the Institute's yardstick of values, up to 1100 points may be accorded a company's fiscal policies, with 825 signifying "excellent." Hinde & Dauch's analysis rating for this subject is 1050. The report says, on this score, "The conservative nature of this company's top management, plus the astute knowledge of its fiscal officers, has resulted in a superb handling of finances. Our study shows improved inventory turnover and improved production per dollar of fixed investment over the years since 1920. Coincident with this improvement has been a discharge of all bonded indebtedness and retirement of all preferred stock. At the end of December, 1952, the company's working capital ratio was 9.7, with 32% in cash or equivalent, 27% in receivables, and 41% in inventories.

"The company's cash account alone was three times current liabilities, which leads us to the conclusion that no other manufacturing company which we have examined so far exceeds Hinde & Dauch in financial strength, as to capital structure, working capital, or net liquid position."

As to treatment of stockholders, the AIM report points out that despite the one-third interest held by the Frohman and Dauch families "outside stockholders have been given all the desired information and have been treated fairly from the standpoint of cash dividends." The latter, it advises, have been made without interruption since the stock was listed on the New York Stock Exchange in 1937.

The Institute is a nonprofit foundation devoted to the study and improvement of management policies and practices. Its headquarters are located at 125 E. 38th St., New York 16, N. Y.

Parsons & Whittemore

To help develop the pulp and paper industry in South and Central America, Africa, and Asia, Parsons & Whittemore Inc., New York, internationally known suppliers of pulp, paper, and machinery for the industry, is launching an extensive "Point Four" type program under which they will engineer, develop, and build complete pulp and paper mill projects in these areas.

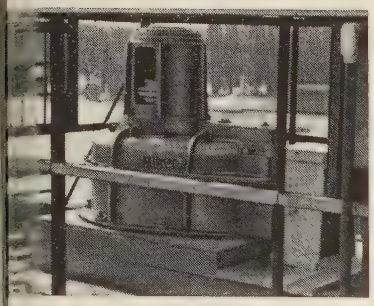
Parsons & Whittemore, Inc., which is observing its centennial in 1953, will develop projects based on pulping of short fibered material found in many of these countries, in addition to offering equipment utilizing standard grades of wood pulp. They will contract to build a complete mill with any specified daily production and quality and will lend assistance to local groups not only in technical and management matters but also in financing.

The company has recently concluded an agreement with the St. Regis Paper Co., one of the world's largest and best known producers of pulp and paper, calling for cooperation between the two firms in the development of pulp and paper mills outside of the United States. Under this agreement St. Regis would consider undertaking management contracts in mills which Parsons & Whittemore develops, thus assuring capacity operation of a salable product.

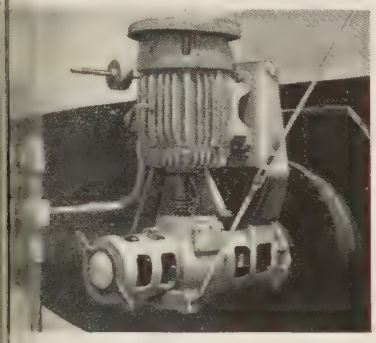
Parsons & Whittemore, Inc., which is affiliated through common ownership with Lyddon & Co., Ltd., London, England, is supported in this field by The Black-Clawson Co., Hamilton, Ohio, leading in paper machinery for over three quarters of a century and its divisions—Dilts Machine Works, Fulton, N. Y., and Shartle Bros. Machine Co., Middletown, Ohio, and their subsidiary, The B-C International, Ltd., London, England.

In Great Britain the organization is associated with Millspaugh, Ltd., with headquarters in Sheffield, England, who pioneered the development of the suction press and vacuum pickup in the paper industry, and its Canadian subsidiary, The William Kennedy & Sons, Ltd., Owen Sound, Canada.

These machine firms are the major suppliers of machinery for the pulp and paper factories which the organization is projecting and their engineering staffs will be available for these projects for delivering to the clients a going plant.



LY UNIFORM STOCK that needs no ...tion at the headbox is produced quickly ...d continuously in vertical chest without ba...les, equipped with LIGHTNIN Mixer ...e this one at an Eastern mill. Sizes to ...0 HP.



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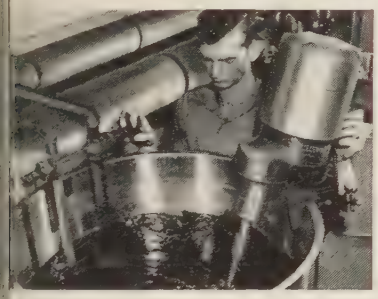

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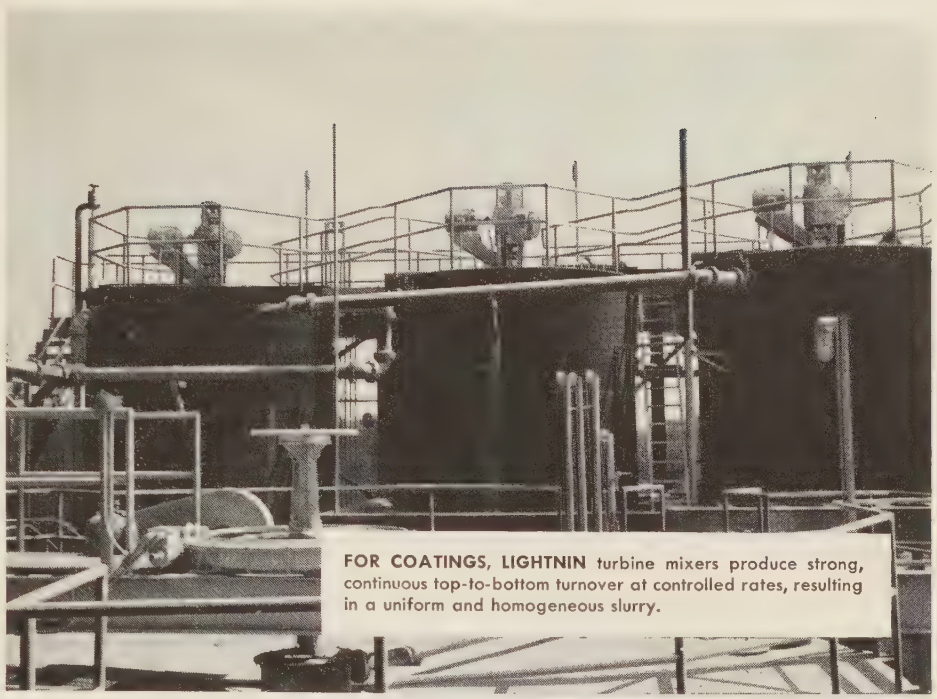

FOR COATINGS, LIGHTNIN turbine mixers produce strong, continuous top-to-bottom turnover at controlled rates, resulting in a uniform and homogeneous slurry.

Why *guess* about fluid mixing when you can *be sure*?

Did you know that fluid mixing, which is so important to the success of paper making, is an *exact science*, not an "art"?

That you can get *accurate prediction of results* in almost any fluid mixing operation?

That you may be using *three times* as much horsepower as you need to get the results you're after? (Tests prove many mills are.)

That *fully uniform* paper stock can be produced quickly in a simple vertical chest, without baffles or midfeathers?

That you can have the protection of a *full* guarantee of mixing results, on practically any LIGHTNIN Mixer installation?

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MIXCO engineers can give you the right answer quickly on any paper mill mixing problem. Technology, based on thousands of successful applications, gives you sure prediction of results. Unique fluid mixing research and pilot-plant facilities are at your disposal without charge.

Why put up with a mixing process that isn't all it should be—all you can rightfully expect it to be? Why wait even another day to start getting the results you can—and should—be getting?

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Combination of these firms, with their large engineering staffs, comprises a development and research organization that is unequaled in the production and installation of new pulp and paper mills on a world-wide basis. For the western hemisphere Parsons & Whittemore, Inc., will have for such new plants and complete units the possibility to have equipment produced by J. M. Voith G.m.b.H., Heidenheim, Brenz, Germany.

It is the intention of Parsons & Whittemore, Inc., to promote these new units in close contact with the consulting engineering profession.

In addition to the technical staffs of the aforementioned companies, which are available for consultation on the paper mill projects, the Parsons & Whittemore-Lyddon organization maintains the Pulp and Paper Research Co., Ltd., in London, where both fundamental and applied research in the adaptability and utilization of bagasse, cereal straw, rice straw, abaca, and other agricultural residues is being carried on.

In this "Private Point Four" program, according to Mr. Landegger, Parsons & Whittemore will:

1. Conduct a preliminary survey and prepare an appraisal report.

2. Engineer the complete project.

3. Produce and deliver all the pulp and paper machinery and other necessary equipment that cannot be produced in the country where the mill is to be built.

4. Supply the necessary trained personnel to insure proper operation of the project until local personnel can take over.

5. Assist the local group in obtaining financing over a period of years.

6. Assist the local group in obtaining the necessary raw materials and chemicals to operate the mill after it is built, as well as sell the output through Parsons & Whittemore's own offices located in 14 countries.

Parsons & Whittemore has recently signed a contract for a mill in Brazil to manufacture a high grade bleached sulphite from Eucalyptus trees. Also being completed is a pulp and paper mill in Costa Rica using abaca fiber as a raw material. Other projects going forward in various parts of the world are based on bagasse, cereal straw, cotton linters, and other papermaking raw materials.

West Virginia

Plans for the construction of a $3,000,000 semichemical pulping addition to present facilities which will increase production by about 200 tons per day were announced recently by L. Frank Thompson, manager of the Charleston, S. C., plant of West Virginia Pulp and Paper Co.

The engineering and designing phases of the project have been largely completed. Considerable work has been done on auxiliary projects, and preliminary construction work, such as excavation and pilings for foundations, is well under way.

Plant officials said construction crews would begin erecting steel about May 1 and that they hoped to complete the job in time to begin operating the new addition during the latter part of the year.

Necessary for the expanded pulping operation will be a woodyard for receiving and handling hardwoods, additional railroad trackage, another barking drum, additional pulpwood chipping facilities, chip conveying and storage facilities, digesters, and additional pulp washing, refining and screening equipment.

The new pulp mill will enable the Charleston plant to utilize some hardwoods, which are fairly abundant in the South, as pulp in some grades of the present product. The mill uses pine pulpwood exclusively in its present operations.

The project calls for the erection of new additions to the present chip house and the digester building. The present washer building will be altered to accommodate the new screening, refining, and washing equipment as well as a ne locker room and shower facilities for pulp mill employees.

The new woodyard will be served by spurs of new railro trackage, now being laid. This project adds a new rail e trance southwest of the mill, which will be linked to the mil present rail network by the addition of, roughly, a half mi of trackage. The new trackage is connected to the Cosgro Ave. marshaling yards of the North Charleston Terminal C by the construction of a trestle over Filbin Creek and anoth increase in trackage by the Atlantic Coastline, Seaboard Ai line Railway, and Southern Railway, operators of the Te minal Co.

The new line will provide the paper mill with a comple rail loop running from the point where present trackag enters mill property from the northwest to the Cosgrove Av yards. In the past, railroads had to move the plant's heav freight on a dead-end track layout which required consta shifting of cars and resulted in considerable congestion in th North Charleston area.

The freight volume at the paper mill has increased almo 200% since operations began here in 1937. On an averag day, the mill receives more than 90 cars of inbound freigh including about 75 cars of pulpwood and 15 cars of misce laneous materials, such as coal, oil, and chemicals. Aroun 35 cars of finished paper and paperboard are shipped by th plant on an average day. The bill for freight moving in an out of the mill now runs about $7,000,000 a year.

In order to provide a sound grade for the new rail trac which was built over swampland lying southwest of the mil the builders resorted to considerable blasting to liquefy layer of muck about 30 ft. deep. About 35,000 lb. of dynamit were used to blast the muck and about 110,000 cu. yd. of fi were dumped into the gaps opened by the charges.

Ecusta

Could a pocket-sized Bible be printed by offset lithograph on ultrathin Bible paper? It could—and proof is offered i the Oxford University Press pocket edition of the Scofiel Reference Bible.

Printed for the Oxford University Press by Robert Telle Sons & Dorner of New York, it marks the first time that a edition of the Bible has ever been printed on ultrathin pape by the offset method. All previous Scofield editions had bee letterpressed.

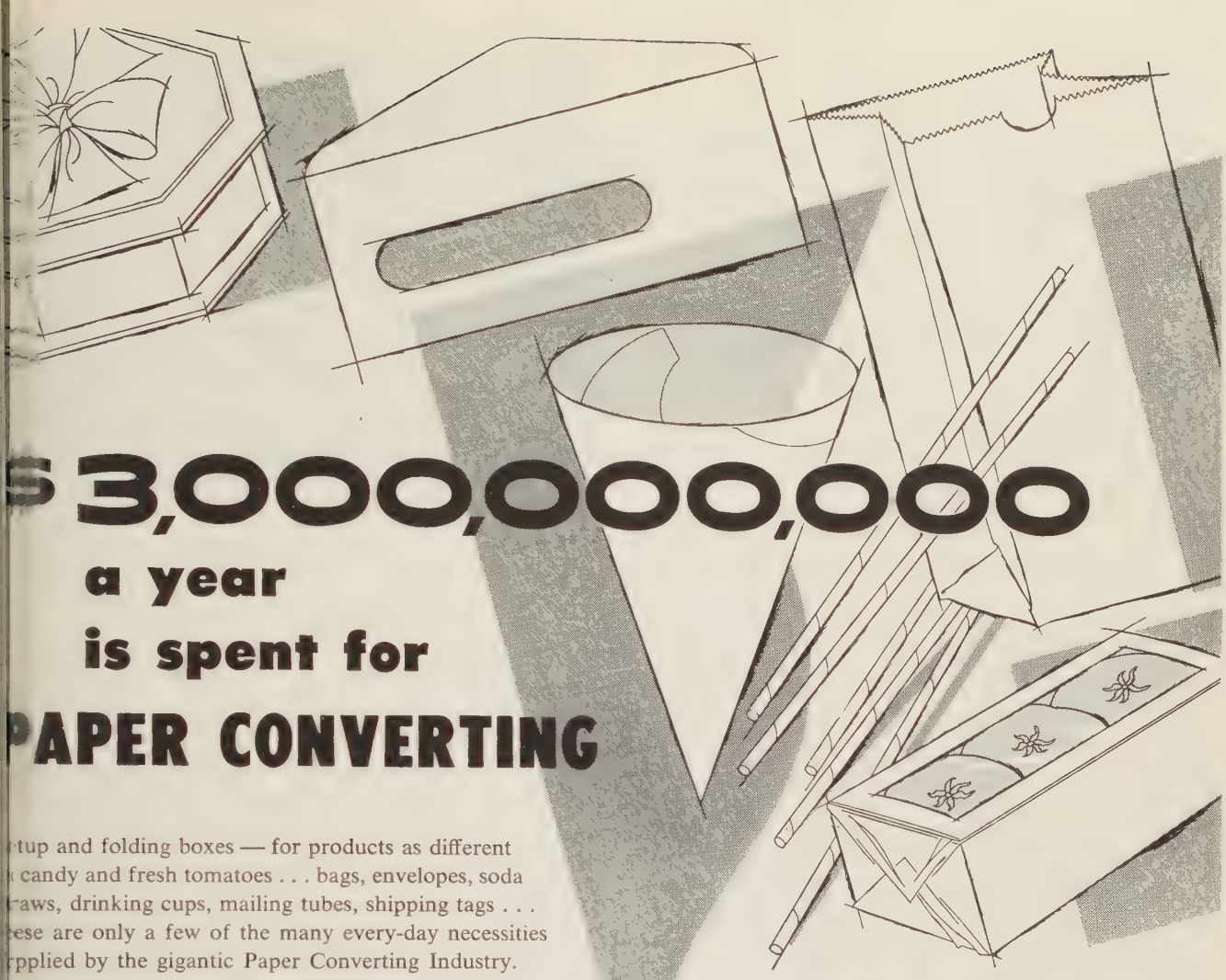
Production of the pocket-fitting, page-for-page facsimil of the standard size Scofield Reference Bible revolved aroun problems of cost and time. Much experimentation was neces sary to determine whether offset printing and binding of th 1368 text pages on ultrathin Bible paper would be physicall possible and commercially feasible.

Albert Teller, vice-president of Robert Teller Sons Dorner, felt sure that the job could be done with cooperatio from the paper suppliers and the binders. A special ultra thin stock had to be developed which would meet give specifications of opacity, color bulk body, and sizing for offse printing. This was where Ecusta entered the scene.

Acting through a New York Agent, the Paper Corp. of th United States, Ecusta supplied the printers with severa different test lots of paper so that the proper type, suitabl for offset printing, could be determined. After testing, was found that a 20-lb. basis sheet would give the best result

Ecusta then manufactured and shipped the amount paper necessary to print the Pocket Scofield Bible, and print ing operations were begun. In just five weeks the first print ing was successfully completed and the Bibles were ready fo binding. This was done by the J. F. Tapley Co., of Lon Island City. N. Y., binders of many previous editions Oxford Bibles.

Only $^{7}/_{8}$ in. thick and $3^{5}/_{8}$ by $5^{7}/_{16}$ in. in size, this outstand ing new edition contains the complete 773,692 words foun in the Old and New Testaments of the King James versio



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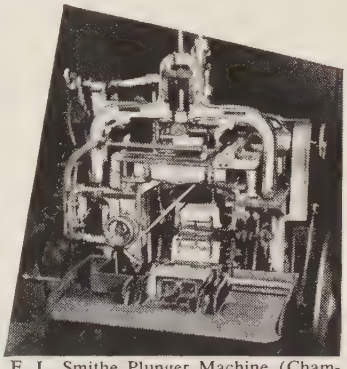

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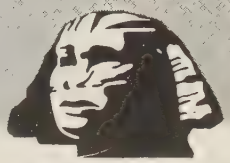

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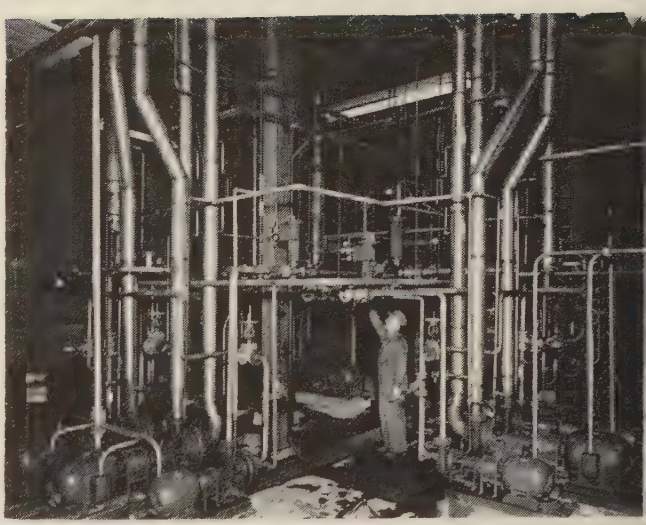
of the Holy Bible. The complete Scofield notes and references are retained and will be found on the pages where help is needed.

Ecusta, manufacturer of the highest quality Bible papers for over 10 yr., is proud of the part it played in the publishing of this fine edition of the Bible. Testimony of the high regard held by Oxford University Press for Ecusta Bible paper lies in the fact that Ecusta has been assured of being awarded the contract to supply the paper for the second printing of the Pocket Scofield Bible.

Not only has Ecusta Bible paper been used in printing various editions of the Bible but for printing annual reports, company histories, rate and data books, calendars, catalogs, pamphlets, advertising "mail-outs," encyclopedias, pocket books, dictionaries, and numerous other publications.

Five standard weights—17½, 20, 24, 30, and 40 lb. are manufactured, with other weights available on special order. Noted for its permanence, strength, high opacity, light weight, and small bulking properties, Ecusta Bible paper easily meets the exacting standards for black and white and multicolor printing in both letterpress and offset printing plants.



Circulation and transfer pumps, level control valves, and one of the submerged heaters (upper right) at the Consolidated Water Power & Paper Co. antipollution plant

Consolidated W.P. & P.

The pulp and paper industry's biggest installation of Rosenblad reversible flow quadruple-effect evaporators was placed in operation here recently at the Interlake mill of Consolidated Water Power & Paper Co.

The installation has capacity to handle the mill's entire supply of collectible spent sulphite liquor. Collected at approximately 13.3% solids content, 200,000 g.p.d. will be evaporated to 60% solids for use as boiler fuel. Burning is in a vertical cyclone type furnace converted to this purpose from designs by company engineers. Experience with this furnace in combustion and ash production will be checked before conversion of another furnace to increase steam output.

Consolidated's management considers the Interlake installation as partially experimental and looks to experience at Appleton for guidance in making its plans to process the sulphite liquor from the company's considerably larger sulphite mill at Wisconsin Rapids.

"We are, of course, sure that the new plant will produce fuel and thus make steam," Stanton W. Mead, company president, stated to the visitors. "We cannot be certain of operating efficiency and actual costs until the plant runs for quite a while. Also there are dozens of technical problems that can be answered only through actual experience.

"We expect that this Interlake installation will provide our company with answers that we need for deciding wisely about our other operations. It is of equally great importance to the interests of conservation that processes which are adopted by the industry to clean up Wisconsin streams shall prove not only effective but also economically supportable."

More than half a million dollars has already been invested in the evaporation and burning plant and subsequent modifications will substantially increase this figure. Long-range plans include the probable installation of high-pressure steam boilers and generating equipment to permit production of power.

Spent sulphite liquor is collected from the mill's nine Mitscherlich digesters and pumped to a sulphur dioxide reclamation system and then to a 79,000-gal. storage tank. From here it is pumped through 60-mesh screens to the evaporator plant.

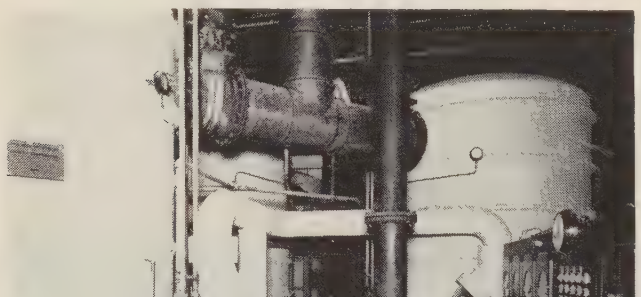
This plant consists essentially of five vapor bodies, two falling film type heaters, and two submerged surface type heaters with counterflow between liquors and vapors. The heaters have 2000 sq. ft. liquor heating surfaces and are interconnected with the five vapor bodies; the fifth body is necessary for alternating liquor and heating surfaces at intervals determined by operations. There are the necessary transfer and condensate pumps and intermediate piping. The piping is constructed so that all pipes carrying liquor in one operation carry condensate in the next operation, thereby flushing these lines to remove scale previously formed. The plant is designed to operate between 35 p.s.i.g. and 2 in. Hg absolute.

All equipment including valves and piping is type 316 stainless steel. Heaters are type 316 extra low carbon stainless steel. All equipment is operated from a control panel board excepting a few periodic operations which require manual control such as switching liquor flow from one side to the other.

The evaporators are designed to evaporate normally 52,900 lb. of water per hour attaining 3.56 lb. of water evaporated per pound of steam. The collected liquor is at about 13.3% concentration on entering the evaporator. It is therefore necessary to remove by evaporation more than 3.5 lb. of water to produce 1 lb. of 60% concentrate. The steam consumption is thus about 1 lb. of steam to produce 1 lb. of the 60% concentrate.

A heat exchanger is incorporated in the system to utilize heat from the condensate to increase the temperature of the liquor between effects.

The evaporator plant was built by Consolidated Water Power & Paper Co. employing throughout the technical and scientific knowledge of the Sulphite Pulp Manufacturers'



Vapor bodies, control panel, and two falling film heaters (background) at the Consolidated Water Power & Paper Co. plant

This Machine Means Business!

This 130″ fourdrinier machine supplies the life blood of American business: bond paper! Without the product it produces, businesses all over America might grind to a slow halt.

Imagine, if you can, a business operated without paper. No paper to write orders on . . . no paper to keep records on . . . no paper to send out bills . . . no paper for correspondence. Without much doubt, it would be pretty tough for any business to operate long without paper.

And it would be equally difficult for this fourdrinier to operate without chemicals. Because Spencer Chemical Company supplies an ever-increasing amount of commercial grade anhydrous ammonia to paper mills using the revolutionary ammonium bisulfite process, each new development in this field is studied carefully.

With the completion in 1953 of new works now under construction, Spencer Chemical Company will be in a position to supply ammonia to a number of additional mills planning to go over to the ammonium bisulfite process. If your mill has such plans, perhaps it would be mutually beneficial to talk it over with us.

SPENCER®

America's Growing Name In Chemicals

Spencer Chemical Company, Executive and General Sales Offices, Kansas City, Mo. Plants located at Pittsburg, Kans.; Henderson, Ky.; Charlestown, Ind.; Chicago, Ill.; and Vicksburg, Miss. (under construction).

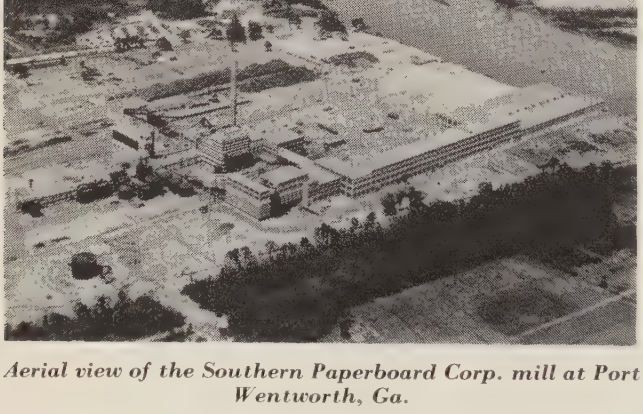
Research League of which the company is a member. The league is the cooperative research organization of 13 Wisconsin sulphite mills and one Michigan mill which jointly support its work in the field of sulphite pollution and by-product utilization. All technical information developed in the Interlake evaporation and burning plant now or in the future is available to all member mills of the League and will be used by them in solving their own pollution problems.

List of Equipment Sources

Heaters and vapor bodies	General American Transportation Corp.
Spiral heat exchangers	American Heat Reclaiming Corp.
Pumps	Worthington Pump & Machinery Corp. Goulds Pumps, Inc. De Laval
Piping	General American Transportation Corp.
Valves	Hasco Valve & Machine Co.
Structural steel	Wisconsin Bridge & Iron Co.
Instruments	Taylor Instrument Cos. Bailey Meter Co.
Tanks	Felker Brothers Manufacturing Co.
Electrical equipment	General Electric Co. Cutler-Hammer Manufacturing Co.
Condenser	Ingersoll-Rand Co. Heresite Co.
Atomizing spray nozzles	Babcock-Wilcox Co.
Fans	Westinghouse Electric Corp.
Dust collector	Pratt-Daniel Co.
Vane feeders	United Conveyor Corp.
Rotometer	Bailey Meter Co. Fischer & Porter Co.
Insulation	Industrial Insulation Co.
Temperature recorder	Leeds & Northrup Co.

Southern Paperboard

The Southern Paperboard Corp. at Port Wentworth, Ga., has started on a major expansion program. By use of the high yield process this expansion is scheduled to increase substantially the mill's capacity.



Aerial view of the Southern Paperboard Corp. mill at Port Wentworth, Ga.

In order to provide sufficient pulp for this increased production, additions are also necessary to the pulp mill and include one new boiler, a turbine, three digesters, and a new refining capacity.

The J. E. Sirrine Co. of Greenville, S. C., are engineers for the project. General contractors are the Daniel Construction Co. of Greenville, S. C., and Birmingham, Ala. Both firms performed similar work on the original mill completed in 1948.

Crown Zellerbach

In a scenic setting on the Columbia River at Camas, Wash., within sight of snow-capped Mt. Hood, stands the Camas Div. pulp and paper mill of Crown Zellerbach Corp.

It is a specialty mill that uses eight different kinds of wood in the production of 14 types of pulp and daily makes over 700 tons of paper into thousand of grades and specifications.

These are then converted into such final Crown Zellerbach products as paperboard, kraft bags, napkins, wax paper, toilet paper, paper towels, and facial tissue.

Pulpwood arrives by water, rail, and truck. Chippers reduce the barked wood to chips, which are carried away by a system of belt conveyors to storage bins, screen room, and finally to the digesters to be cooked with the proper chemicals in the manufacture of pulp.

Specially converted open-top box cars also bring chips to the Camas mill from sawmills in Oregon and Washington, where chips are now made from refuse wood that would formerly have been burned or wasted.

Notable among recent improvements and additions at Camas is a modified Bellingham-type hydraulic barker followed by a revolving arrangement for spudding logs, a log washer, and a six-knife, 153-in. diam. Sumner whole-log chipper, with an integrated conveyor system from chipper to storage silos and succeeding operations.

A particularly outstanding feature of this conveyor system is a 72-in. wide roller-bearing rubber belt conveyor from feeder-conveyor under chipper to the tops of six 75-ft. high, 44-ft. diam. concrete silo storage bins, each having capacity to hold 400 units of chips.

This 72-in. wide belt conveyor is unusual for two reasons, viz: (1) its great width and (2) its depth of carrying capacity because the conveyor belt rides on Link-Belt Series 400 roller bearing troughing idlers equipped with 6-in. diam. equal-length interchangeable steel rolls, with end rolls set on a 45-degree slope.

Link-Belt engineers pioneered these 45-degree end rolls as a means of obtaining greater troughing effect and carrying capacity from the same width of conveyor belt when transporting such relatively light materials as wood chips and hogged fuel.

And it is estimated that, in the 72-in. width, this chip conveyor at Camas has increased the handling capacity as much as 60%.

This 72-in. belt, built by Pioneer Rubber Mills, operates on a conveyor centers of approximately 500 ft. at a belt speed of 330 f.p.m., and has been in service a little over three years.

The foot end of conveyor has a horizontal run of 50 ft. followed by a 250-ft. incline of 19 degrees up to the horizontal run over the storage silos.

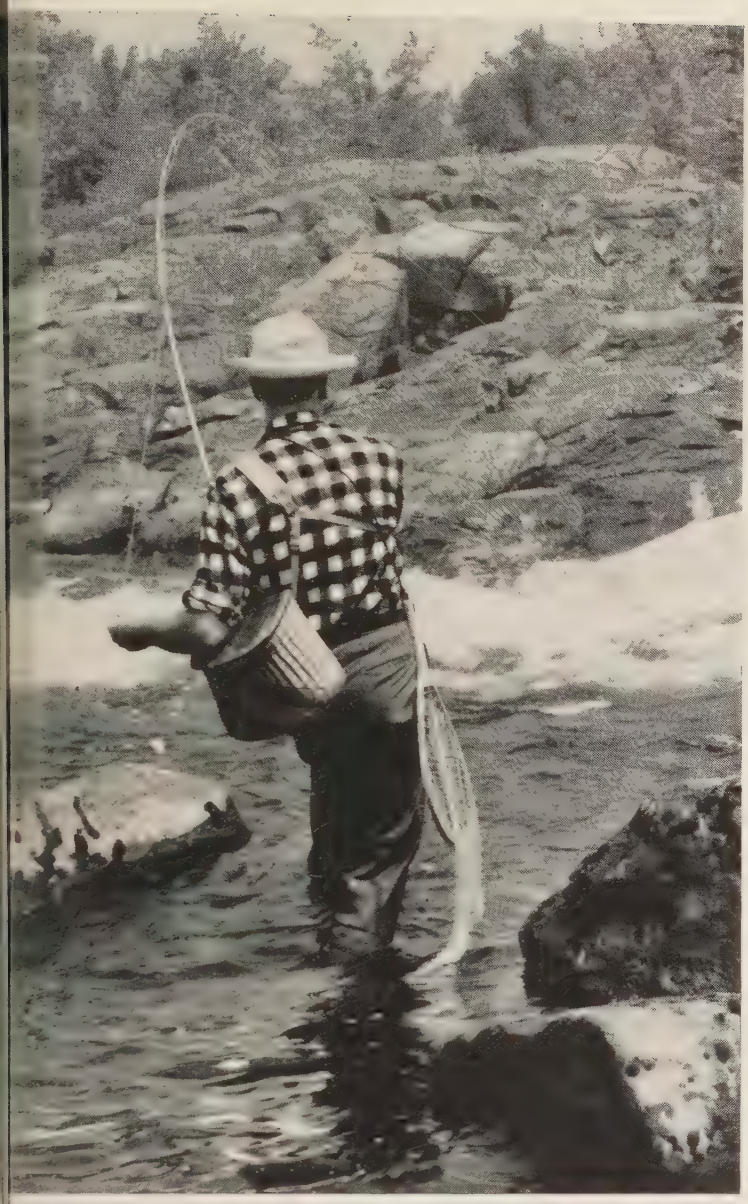
The feeder-conveyor from whole-log chipper delivers to horizontal run of belt at a point close to start of incline.

Chips from rail cars can be delivered to horizontal run of 72-in. belt at a point closer to foot end. This permits the conveyor to carry chips from both sources simultaneously.

On the first day of our visit to Camas, no chips were being made, or being handled on the 72-in. belt, so we decided to photograph the conveyor empty, with camera pointed up the steep incline. To this writer, the conveyor here looked like an enormous bath tub as long as the incline.

When we returned to the Camas mill later in the week, a picture of chip handling over the silos was made. This shows the moving of a good volume of chips from one source only (the whole-log chipper) but also illustrated the added capacity that the belt provides for handling shipped-in chips at the same time.

Another thing to bear in mind is that, although some large logs were being chipped, they were by no means the largest and that the volume of chips is much greater when a log as large as 36-in. by 40-ft. long (the maximum size) enters the powerful 153-in. diam. chipper.



WIN A PRIZE in the Second Annual Tenax Fishing Contest

SPONSORED BY
LOCKPORT FELT COMPANY
FOR

Paper, Pulp and Paperboard Mill Employees

ANYWHERE IN THE U.S.A.

Knowing how many of you get great pleasure out of shing, Tenax Felts are giving you something extra to fish or . . . 46 worthwhile prizes. We sincerely hope you will be ne of the lucky ones to win a prize this year.

These Prizes must be won!

NATIONAL GRAND PRIZE
10 H.P. JOHNSON OUTBOARD MOTOR

For the fish nearest the weight of all-time record fish of same variety, as listed in FIELD AND STREAM RECORD BOOK.

15—1ST PRIZES ..... $100 SAVINGS BOND
(1 each variety of fish listed on official entry blank)

15—2ND PRIZES $50 SAVINGS BOND
(1 each variety of fish)

15—3RD PRIZES ..... $25 SAVINGS BOND
(1 each variety of fish)

Get your entry blanks at your own mill now

See your bulletin board or ask your mill foreman for easy contest rules, official entry blanks and list of fish for which prizes will be awarded. Contest starts April 1—ends midnight, October 1, 1953. Get started early—because in this contest amateurs can win as easily as experts. First, second and third prizes will be awarded in *each* of 15 separate classes—for the heaviest of 15 different varieties of fish, from yellowtail to largemouth bass! In addition, you may win the National Grand Prize! *So . . . let's go fishin'!*

LOCKPORT FELT COMPANY • NEWFANE, N. Y.

A 36-in. wide flat belt conveyor handling chips received by rail, parallels the 72-in. troughed belt above the storage silos. Discharge of chips to any desired silo is effected by plows hand-set across the belt, as illustrated.

Chips from different species of logs are kept in separate silos.

The bottom of each silo is fitted with a structural steel conical bottom to permit proper discharge through the medium of a Link-Belt rotary 17-ft. diameter circular table feeder operated from a 20-hp. electric motor through suitable enclosed gear reduction.

At the bottom of silo 4, containing hemlock chips, each rotary feeder has a hand-wheel-operated adjustable plow which can be placed in any desired position to regulate the volume of chips plowed off to reclaim conveyor.

Reclaim belt from line of six silos to screen room is 42 in. wide.

Weyerhaeuser

To the layman, tree farms are forest areas managed to grow crop after crop of trees. To scientists, these forests are vast natural factories manufacturing wood fiber and chemicals from soil, air, and water—energized by sunlight. Basic pulp research is concerned with the study of wood fibers and their basic component—cellulose. This material—once the living cells of the growing tree—is the complex substance from which paper, rayon, cellophane, explosives, and many other allied products are made.

Pulp research activities must be flexible—they are coordinated by management with sales, production, and engineering. The company's policy of whole-crop utilization and product diversity must also be considered. Pulp research must be adaptable to changing market requirements and new techniques in harvesting. Since chemical pulps are tailor-made to meet the requirements of individual markets, research activities extend beyond the development of products and methods. Quality control and continuous testing procedures are necessary for precise large-scale pulp production. Cooperative research studies with major consumers on technical and production problems have resulted in better products for highly competitive markets.

Company pulp scientists pioneered the production of bleached Douglas-fir pulp as a prime papermaking fiber. This application of the kraft process resulted in the economic conversion of sound wood usually left over in logging and sawmilling operations. An amount of wood equal in weight to 450 million board feet of logs has gone into pulps for paper and packaging.

Utilization and disposal of waste materials from pulping operations have been a major research problem. Persistent experimentation resulted in the adoption of the magnesium oxide process by which pulping chemicals are recovered and noncellulose residues are burned to develop vast quantities of power required in pulp processing. This process was installed in the Longview sulphite plant in 1948—the first acid pulping operation for complete wood utilization with elimination of the stream pollution problem.

Atmospheric and stream pollution problems are closely related to all pulping operations. Continuing studies are necessary for minimizing and controlling the toxicity and oxygen demands of material thrown off during production.

Cellulose is the most abundant organic chemical on the earth's surface and wood is the largest and most practical source of this material. Continuing research in all phases is carried on so that more new and better cellulose products can be economically manufactured.

Important Events in Pulp Research

1931 Company produced first pulp in its sulphite mill at Longview, and research begun to provide a constant standard of production quality

1933 Pulp research laboratory established at Longview with 10 men, who carried on comprehensive and continuous pulping and bleaching studies on acid and alkaline pulping methods. They also investigated various possibilities for sulphite waste-liquor utilization, including special chemical products (lignin, tannin, and vanillin) and methods of burning liquors for process chemicals and heat recovery

1938 Pilot plant built for magnesium oxide (MgO) sulphite waste-liquor recovery

1941 Wartime research begun to develop high alpha pulp for smokeless powder. Beginning of research on full bleached sulphite pulp for photographic paper, rayon and cellophane

1942 First hydraulic barker installed at Everett, pioneering company programs for waste-wood utilization

1946 Construction begun on MgO recovery plant and bleached sulphate operation at Longview

1947 First rayon pulp production at Everett mill

1948 After considerable exploratory work, studies initiated toward producing high-purity kraft pulp. Marine biological research begun to establish safe concentration limits of pulp mill wastes in fresh and salt water. Odor elimination studies begun

1950 Research under way leading toward improved kraft process container boards

1951 Expanded research facilities to study problems of improved pulp qualities for high-grade papermaking and new pulps for a variety of special products.

Forest Products Laboratory

A Box Strength Calculator, recently developed at the U.S. Forest Products Laboratory, Madison, Wis., is included in Report No. R1911-A, "Basic Design Data for the Use of Fiberboard in Shipping Containers." This calculator can be used (1) to calculate the top-to-bottom compressive strength of an A-, B-, or C- flute corrugated fiberboard box or a solid fiberboard box having a perimeter up to 400 in.; (2) to calculate the dead load that a box can be expected to sustain for a specific time in storage; (3) to interpret the compressive strength of a box at one moisture condition of the fiberboard in terms of other moisture conditions; and (4) to determine what strength properties are required of the component sheets in order to provide a box that meets specific use requirements. This report is one of a series issued in cooperation with the Quartermaster Food and Container Institute for the Armed Forces.

Hoberg

Construction is scheduled to start within a few weeks on Hoberg Paper Mill's $2,500,000 torula yeast process project to cut sulphite pollution in the Fox River and Green Bay.

A contract was awarded recently to Chapel and Amundson of Green Bay, Wis., to build a 3200-ft. tunnel connecting the company's two mills in Green Bay. This tunnel, costing $373,000, will supply steam from the paper division's boiling plant to operate the yeast plant, which will be built alongside the company's sulphite pulp mill. Completion of this tunnel is scheduled for next Fall.

Interior of the tunnel will be $6\frac{1}{2}$ ft. square, and its top will be from $7\frac{1}{2}$ to 15 ft. below ground. It will proceed several blocks under city streets between the two Hoberg mills. Besides the actual construction work the paper company has agreed with the city to pay the full costs of restoring to previous good condition everything disturbed in the course of the job.

In building the tunnel, the contractor will excavate 40,000 cu. yd. of earth and use this dirt to fill low areas in the company's Division B yard. This is more than ten times as much earthwork as that done by the city last Summer in paving 3200 ft. of a Green Bay street with concrete.

The tunnel itself will have floor and walls of reinforced concrete. This will require more than 2800 cu. yd. of concrete and 296 tons of steel.

Two other phases are involved in Hoberg's antipollution project. Major rebuilding must take place at the pulp mill so that spent sulphite liquor which now flows directly to the stream can be collected for processing. The yeast plant itself must be built and equipped for actually removing from

PENFORD GUMS

(Starch hydroxy ethyl ethers)

(U.S. Pat. #2,516,632, #2,516,633, and #2,516,634)

The use of Penford Gums is rapidly and widely expanding in the Paper Industry. The unusual properties of these gums as outlined below offer new and substantial advantages for calender size, size press and tub size, coating and beater addition and other paper processing.

CALENDER SIZE

To Increase Mullen, Penford Gum 280, a high fluidity starch ether is used in concentrations of from 6% to 8% solids at a temperature of 190°F. This calender application greatly increases mullen on all types of board. An average consumption is about 8# to 15# Penford Gum 280 per ton of 16 point board.

For High Gloss Ink Printing And Reducing The Penetration Of Wax, Oil, Glue, And Other Finishing Agents, the medium fluidity starch ethers such as Penford Gum 240, 250 and 260 are used. When these products are used respectively in a 4%, 5% and 6% concentration at a temperature of 130°F to 140°F, a proper finish for high gloss ink printing is developed. The results are comparable or superior to much costlier finishing agents.

For Eliminating Fuzz And Controlling Density, the low fluidity starch ethers, Penford Gum 200 and Penford Gum 240 are used. Due to their high viscosity and resultant non-penetrating properties, these products are used at concentrations as low as 1½% solids and at low temperatures.

SIZE PRESS AND TUB SIZE

The Surface may be sealed by using the surface sealing, viscous Penford Gums, or mullen and fold may be increased by using the thinner Penford Gums.

COATING

As a Coating Adhesive Penford Gum 280 is used by itself or with resins for medium-high concentration machine coatings. All Penford Gums are extremely reactive with urea formaldehyde resins and produce high pick coatings. Penford Gums 250, 260, 270 and 280 are used alone or with latex emulsions in smooth pigmented size press coatings. Coating weights from 4 to 13 pounds per ream are being produced, and these coating formulations may be water-finished on calenders if desired. The pigment may vary from clay to all titanium dioxide.

BEATER

For beater addition, the Penford Gum 200 may be used either cooked or raw. Because of the lower gelatinization temperatures of the Penford Gums, the raw starch will swell and gelatinize in many sheets as they are formed.

Write us for our recommendations on the particular grade of Penford Gum best suited for your specific operation.

PENICK & FORD, LTD.,

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the liquor the wood sugars which consume the oxygen from the river water and thus drive away fish. Orders for equipment to be used on these phases of the project are currently being placed.

Frozen Foods Packaging

There are few industries which offer a market for so wide a variety of packaging materials as does frozen foods. In canned goods, packaging is limited to a standard tin: in ice cream one style of carton is employed. But frozen foods cover *practically everything* we eat and include liquids, semi-liquids, and dry packs. This opens the field wide for waxed papers, cellophane, polyethylene, various types of laminations, foil, cartons, metal-end containers, metal cans, and possibly plastics.

In 1952, in rough figures, the frozen foods industry offered a very sizable quantity of products to be packaged. This included about 600 million pounds of frozen vegetables in retail containers and another 200 million pounds in institutional sizes; 375 million pounds of frozen fruits in institutional $6^1/_2$, 10, and 30-lb. tins and cartons and another 125 million pounds in retail containers, including metal end packages and $10^1/_2$-oz. tins; 800 million 6, 12, and 32-oz. concentrate cans and 350 million pounds of retail and institutional packages of poultry. Also, about 90 million pounds of quick frozen meat cuts, over 300 million pounds of seafoods and shellfish and another 90 to 100 million pounds of various specialty items.

Almost every month brings a host of new frozen products upon the market—and each product offers a challenge to the packaging manufacturer. Two years ago the industry switched to colorful vignette labels and frozen food packages today are among the finest to be seen in any line. *More new labels* are being designed than ever before. The increasing use of round tins for some products also offers new opportunities to lithographed label manufacturers.

Never, however, was there *so little* standardization as today. Staple vegetable packages are now mostly 10 oz., but smaller sizes prevail, too. Strawberries, peaches, raspberries, boysenberries, etc., will probably standardize on 10 and 12-oz. sizes this coming year. The reason is, of course, sharpening competition and the offering of smaller packages with their attendant price advantage. This irregularity in size is further prompted by the sale of B grade merchandise, which also tends to smaller sizes. The extent to which the 10-oz. pea carton for instance, has pushed the 12-oz. size out of zero cases is mirrored in reports of the Natl. Assn. of Frozen Food Packers. The latest pack figures show 74 million pounds of peas put up in 10-oz. size as compared to 40 million in the 12-oz. The previous year only 18 million were packed in 10-oz. and 101 million in 12-oz. size. Because of the wide range of foods which freezing covers there will *always* be odd-sized packages, but eventually packages which can be standardized, such as vegetables, fruits, shrimp, fillets, and poultry packages will be more uniform.

Packaging machinery in frozen food plants is now valued between 10 and 15 million dollars. Most plants have from two to 10 high-speed wrapping machines doing a complete job of opening cartons, filling, sealing, and overwrapping up to 300 a minute. Besides this, packers use filling equipment, scales, bag sealing machines, carton closers, automatic carton openers, fillers and sealers, heat sealing equipment, etc. A new development is "bundling" of retail packages in 6's and 12's on the packaging line before placing into shipping containers. This is an important improvement which saves in labor and handling, and it should become universal soon.

The main requirement of a frozen food package is that it should give protection for at least 12 to 18 mo. and be handled at high speed. With a production of 10 billion pounds seen by 1957, the frozen foods industry will eventually offer packaging manufacturers a field of unrivaled importance.

HERMANN *Improved* CLAFLIN

"Continuous Beater & Refiner"

"HOT STOCK" REFINING

PRE-BEATING SALES GRADE PULPS

PRE-BEATING FOR OWN CONSUMPTION

CONTINUOUS BEATING IN THE PAPER MILL

"Complete Data Available Upon Request"

Exclusive Sales Agent: THE EMERSON MFG. CO., LAWRENCE, MASS.

THE HERMANN MFG. CO., LANCASTER, OHIO

MARATHON

The slickest way of solving the pollution problem is to convert the objectionable material to something useful, then sell it. And though that's easier said than done in most cases, some companies have attained a modicum of success with just that sort of reasoning. Marathon Corp. (Rothschild, Wis.), has had, for 15 years, a Chemical Division that uses as raw material the spent sulphite liquor from the firm's pulping operations.

Making the proposition pay was an uphill struggle most of the distance. The history of the Chemical Division, in fact, was written in red ink until 1945. But it was in the black that year, and has been paying its own way ever since. And this week, Marathon is adding another chapter to the book: having just completed a half-million-dollar expansion of facilities, the Chemical Division reports that demand for its products now outstrips its raw material and it is buying spent liquor from another pulper.

New facilities consist of 13 large process tanks and four major pieces of equipment. Included in this is a spray drier—the largest ever built by the Western Precipitation Corp. The net effect will be to boost Marathon's output of lignosulphonate powders by 15 million pounds a year. Total annual production will then be 39 million pounds of powders and 36 million pounds of solids as liquor products.

The basic building block for Marathon's Chemical Division is lignosulphonic acid found in the spent liquor. It had long been known that the acid could be precipitated as the calcium salt by treatment with lime. Marathon, however, was the first to prescribe the exact amounts of lime in its patented (U.S.P. 1,699,845; 1,856,558), three-stage precipitation. In the first stage, lime is added until the pH rises to 10.5. That brings down calcium sulphite which can be used in preparing cooking acid. Most of the sulphonic acid precipitates in the second stage when the pH is raised to 12.

The remaining liquor is then treated with an excess of lime to remove more lignin. That plus the excess lime can be employed in the first stage. The mother liquor contains degradation products with a low biochemical demand for oxygen. It causes no pollution problems when released to the stream.

Earliest use for the calcium lignosulphonate was in the production of vanillin. Marathon dissolves the salt in caustic and pipes it to Salvo Chemical Co. (Rothschild, Wis.), a subsidiary of Sterling Drug Co., where it is oxidized to the vanillate. Even today, points out Marathon, Salvo produces over 50% of the vanillin consumed in the U. S. with a process developed jointly by Salvo and Marathon and from liquor purchased from Marathon.

A number of lignin compounds have joined vanillin in finding a market in industry since the calcium salt can be modified in many ways. Calcium itself can be replaced with sodium, potassium, magnesium, ammonium, aluminum, zinc, copper, chromium, or iron. The basic structure of all these can be altered by changing temperature, pressure, pH, degree of oxidation, or other variables.

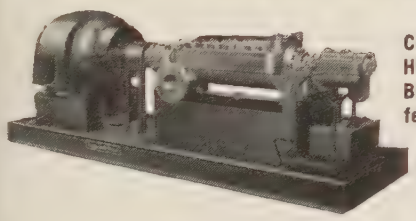
With the new facilities, Marathon looks forward to a 50% boost in gross sales for the Chemical Division by 1954. Most of this increase is expected to come from present markets, but Marathon says it will have enough left over to explore new uses. Here's a brief rundown on how Marathon expects the market will shape up:

The big claims for lignin compounds as dispersants are their powerful action and low cost. Dispersants have been the biggest part of the Chemical Division's business and Marathon expects they will continue so.

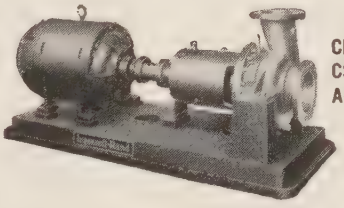
Oil-well drilling muds are a major end use. They use Marasperse CK calcium lignosulphonate to control fluidity, also to stabilize emulsified-oil muds against electrolytes or jetting and churning encountered in drilling operations. Another dispersant, Marasperse CE, is designed for use in stabilizing emulsions in the presence of saturated brines.

RIGHT THROUGH THE MILL

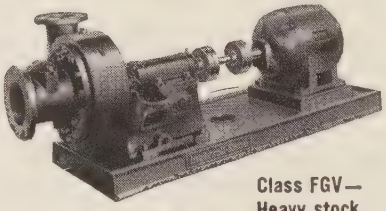
FROM BOILER FEED TO PAPER MACHINE . . .



Class HMTA—Boiler feed



Class CSFL—Acid



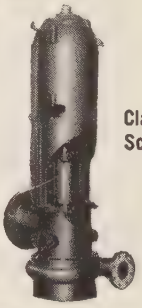
Class FGV—Heavy stock

You can depend on Ingersoll-Rand pumps

That's why so many pulp and paper producers have repeatedly installed I-R pumps—to modernize and increase the capacity of their present facilities, or as a part of a completely new mill.

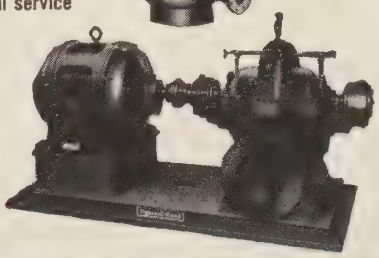
In the complete line of I-R pumps, you'll find a unit that's *right* for any service . . . a pump that is completely engineered—in design, construction and materials—to match the requirements of each application.

An Ingersoll-Rand engineer will be glad to consult with you about your problems and the solution that I-R pumps can provide.



Class VGV—Screened stock

Class ALV—White water and general service



660-10

Ingersoll-Rand

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PUMPS • DIESEL ENGINES • ROCK DRILLS • CONDENSERS • COMPRESSORS • AIR AND ELECTRIC TOOLS • VACUUM EQUIPMENT

"Runny" lubricants don't stay put. You have to replace them frequently . . . maybe as often as once an hour in some locations. And "runny" lubricants drip, splatter and puddle.

USE THIS PERFECT LUBRICANT *THAT CLINGS!*

Magnus Kling-Oil is a safe and sure lubricant with an S.A.E. viscosity of 30. BUT although mobile, Kling-Oil is also "tacky." It clings where it is applied and it STAYS PUT. When you use it at any location where manual oiling is required, you'll find that you'll get sure lubrication for much longer periods without drip and splatter.

Cut Power Consumption . . . End Messy Floors

Usually the steadier lubrication of Kling-Oil shows up on the wattmeter in lower power consumption. Inevitably the puddles and splashes of "runny" oils are eliminated, with consequent reduction in cleaning costs and in fire and safety hazards.

Give It a Trial

We'll gladly send a liberal sample of Kling-Oil so that you can give it a thorough workout on some of your machines.

magnus

MAGNUS CHEMICAL CO., INC.
104 South Ave., Garwood, N. J.
In Canada: Magnus Chemicals, Ltd., Montreal
Service Representatives in Principal Cities

Marathon figures the immediate potential for its dispersants in drilling muds at 20 million pounds, thinks eventually they might take 40 million pounds of the estimated 60-million-pounds market for organic drilling mud dispersants.

A partially desulphonated sodium lignosulphonate (Marasperse CB) finds its way as a dispersant into carbon black for the production of black masterbatch for synthetic tires. Controlled desulphonation renders the material insoluble in acid so the carbon black dispersion and GRS latex will co-precipitate with acid to form an intimate, uniform mixture.

Other uses for lignosulphonate dispersants: in pigment (insoluble), dyes to prevent flocculation of the finely ground particles; in insecticides, to eliminate agglomeration of clay and insecticide particles and retard settling out; in metal cleaners, to prevent redeposition of dirt and to allow dirt-free rinsing.

Marathon claims that almost all of the water treatment compound manufacturers in this country and in Canada use Maracell E in their formulations to prevent scale formation.

Likewise, it says, a majority of the batteries produced in the U. S. employ Maracell C partially desulphonated sodium lignosulphonate as an expander in the negative plates.

In this field, Marathon sodium lignosulphonate can compete with vegetable tans as a leveling agent. It's an established use, but one which Marathon thinks will grow rapidly.

Experiments indicate lignin derivatives may pan out in other fields, too, says Marathon: as a stabilizer for emulsions of wax or asphalt in water; in electroplating baths and phosphatizing compounds; on paper manufacture for cleaning pitch from rolls and screens; in grinding Portland cement clinkers and in gypsum board manufacture. In ore beneficiation (especially nonmetallic), lignosulphonate dispersants are being used in flotation circuits. Other varied industries such as wallpaper and ceramic ware are starting to use specific lignin derivatives.

Since the inception of the Chemical Division in 1937, Marathon has spent $1.75 million on plant and equipment, $2 million on research. It started off with a waste disposal problem, figures that has long since been solved. It's now faced with the happier problem of finding more "wastes" to use as raw material. (From *Chemical Week* (Feb. 7, 1953).)

Oxford

Oxford Paper Co. has announced that effective immediately arrangements have been made with the Martin Cantine Co., Saugerties, N. Y., for the manufacture on part of the Cantine Co.'s facilities of a substantial portion of Oxford's standard line of Conversion Coated Papers. This arrangement enables the Oxford Paper Co. to better service its customers and improves the company's competitive position.

Oxford Conversion Coated Papers manufactured at Saugerties will be made to Oxford quality standards and specifications and will be produced under Oxford on-the-spot supervision. Base stock will be made at Oxford Paper Co., Rumford, Me. Oxford's completely integrated resources assure Cantine a continuing raw material supply for Oxford Conversion Coated Papers. The line will be identical in grades, sizes, and weights to the widely known Oxford Conversion Coated line manufactured for the past 40 yr. at Rumford, Me. There will be no change in packaging or labeling.

Oxford Conversion Coated Papers will continue to be merchandised and promoted through the medium of trade magazine advertising, brochures, sample books, etc., as part of Oxford's over-all advertising and sales promotion program. Oxford quality, service, and delivery will be maintained at the same high standards as in the past.

Tall Oil

The Rust Engineering Co., of Pittsburgh and Birmingham, has been awarded a contract for the construction of a new tall oil processing plant for Newport Industries, Inc., at Bay Minette, Ala.

Newport has been engaged in the processing of tall oil at Bay Minette since 1948 and the new plant will provide capacity for anticipated additional demands for the products now manufactured and capacity for a number of new products developed in the company's Research Laboratory in recent years. Newport operates plants in Florida, Alabama, and Louisiana for the production of wood naval stores from pine stumps, with headquarters at Pensacola, Fla. The new plant marks an expansion of Newport's diversification program begun several years ago. Raw material from kraft paper mills in the area will be processed into a number of products used in the manufacture of soap, lubricants, resins, paints, and for other industrial uses. The estimated cost of the plant is $2,700,000 and construction work has already started.

Engelmann Spruce Bark Beetle

A spruce bark beetle outbreak that began last Summer in a timber blowdown area extending from northern Washington to the Continental Divide in Montana now threatens upward of 6 billion board feet of Engelmann spruce.

Despite all-out efforts by timber operators in the area to salvage blowndown timber, beetles have multiplied rapidly in the storm damaged region. Foresters estimated the spruce bark beetle epidemic will increase rapidly in 1953 and 1954. Unless a speedy control program by logging and treating of infested areas is started early in 1953, nearly half the Engelmann spruce in the region may be lost.

At a recent meeting in Spokane forest industry people, working with representatives of the U. S. Forest Service and the Bureau of Entomology, mapped a control program for the bark beetle infestation.

Their plan calls for removal of 461,000,000 board feet of infested and salvage spruce in 1953 and 800,000,000 board feet in 1954; construction of 755 miles of main road at estimated cost of $10,000,000 for government and $5,000,000 for industry; expenditure of another $5,000,000 by industry for secondary and spur roads; and a supplemental control plan for chemically treating individual trees at an estimated cost of $1,346,100 for the calendar year 1953.

Industry is already pushing its part of the program and has been building roads and logging in infested areas throughout the Winter. The complete program, however, is dependent on appropriations by Congress to assure full federal participation.

Stands of Engelmann spruce threatened by the beetles would create a labor and lumber value estimated at half a billion dollars.

George Neils, of J. Neils Lumber Co., Libby, Mont., is chairman of the industry committee that met in Spokane to map the beetle control program. Others on the committee include: George Neff, Missoula, Mont., Ed Rettig, Lewiston, Ida.; P. D. Edgell, Seattle; Art Roberts, McCall, Idaho; G. A. Miller, Kalispell, Mont.; James Brown, Jr., Sandpoint, Idaho; Hanley A. Morse, Coeur d'Alene, Idaho; and E. L. Kolbe, Portland. P. D. Hanson, regional forester from Missoula, heads the Forest Service group.

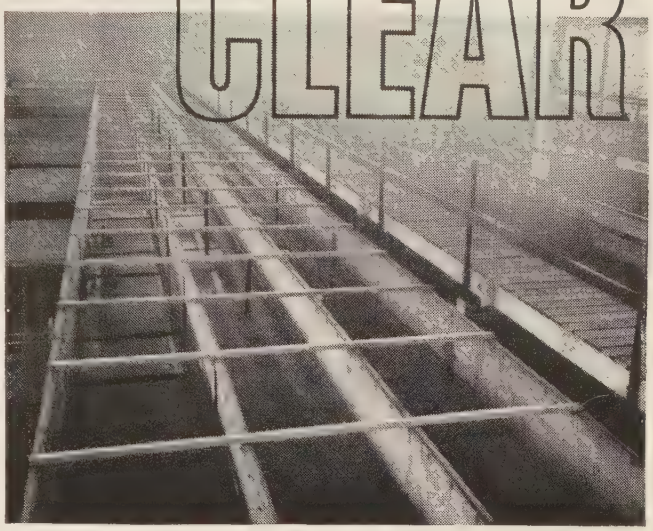
Logs vs. Pulpwood

Pulpwood cannot be considered logs according to a recent ruling of the Clinton County, Pa., court. The decision, handed down by Judge Charles Scott Williams of the 29th judicial district of Pennsylvania, came in a case brought by the state against a pulpwood trucker charged with "improperly fastening logs."

"We are of the opinion that pulpwood cannot be considered logs," Judge Williams stated. "Pulpwood is not so construed according to the rules of grammar and according to common and approved usage, and therefore the defendant in the case is not guilty of any violation."

The judge went on to state that in his opinion, even if pulpwood was to be considered as logs, the defendant would not be in violation of the state law, since the wood was secured by

RAINY RIVER WATERS COME CLEAR



— for Minnesota and Ontario Paper

Rainy River water has color ranging from 40 to 80 ppm, making it unusable for bleached pulp and paper. The Minnesota & Ontario Paper Company successfully reduces color to a range from 2 to 4 ppm through use of two horizontal Permutit® Precipitators and five gravity filters. The cost for chemicals averages less than 1.5¢ per 1,000 gallons. The purity, low color and lack of turbidity make the effluent water ideal for production of high brightness pulps and papers.

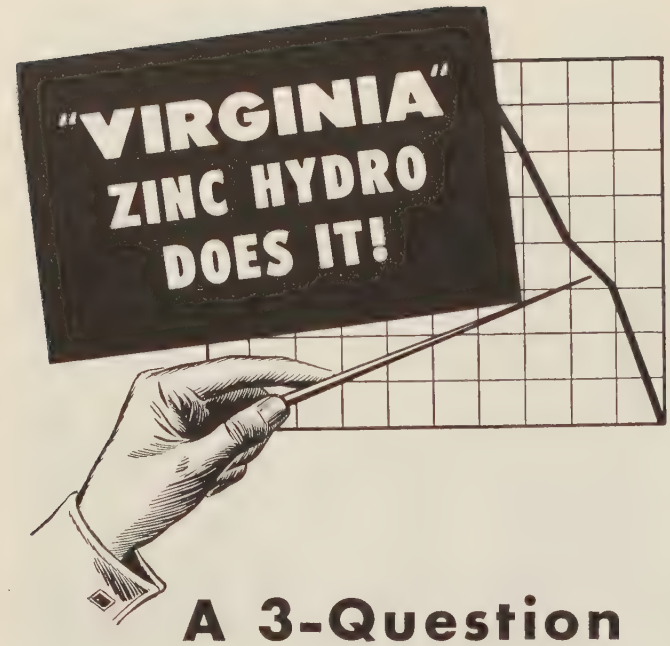
Here is yet another case where Permutit know-how and equipment have helped produce finer pulps and papers, regardless of the original state of the water supply. For full information, write to The Permutit Company, Dept. TAP-4, 330 West 42nd St., N. Y. 36, N. Y. or to Permutit Company of Canada, Ltd., 6975 Jeanne Mance St., Montreal.

PERMUTIT *CONTROLLED* PROCESS WATER MEANS:

- Clean, high quality paper products.
- Higher production—lower production costs.
- More sales . . . bigger profits.

PERMUTIT

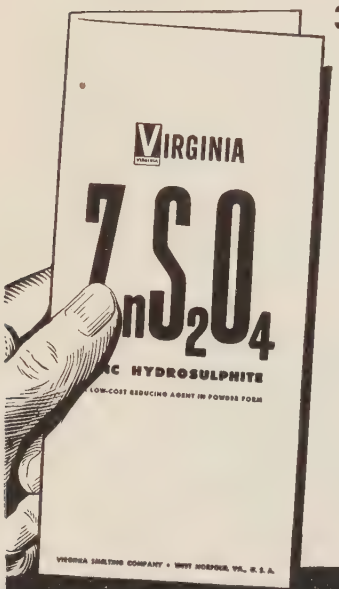
WATER CONDITIONING HEADQUARTERS FOR 40 YEARS



A 3-Question Quiz on Economy

"Virginia" Zinc Hydro has been used as a groundwood bleach long enough for its brightening properties to be proved. Groundwood mills contemplating installation of a bleaching process should consider these questions:

1. What increase in brightness can be expected?
2. What will be the ton cost per unit of brightness to bleach with Zinc Hydro?
3. Is a capital investment for auxiliary equipment required in the Zinc Hydro process?



When you have the answers to these three questions, we predict an acute interest in "Virginia" Zinc Hydrosulphite. May we send you the answers with a product sample for testing purposes?

VIRGINIA SMELTING CO.
Dept. 77-P, West Norfolk, Va.

Field Offices:
NEW YORK
BOSTON
DETROIT
CHICAGO
PHILADELPHIA
ATLANTA

VIRGINIA *Chemicals*
SINCE 1898

three chains. Testimony showed the defendant, hauling wood to the New York and Pennsylvania Co. paper mill at Lock Haven, had two chains running through the tier of pulpwood and a third over the top.

According to expert testimony given at the trial a log is considered to be a "cylindrical portion of a tree, natural in shape, 8 ft. or longer in length, with a minimum diameter of 8 in."

Maine Tree Farm

Maine's largest tree farm, a well-managed 86,043-acre property located in Penobscot, Hancock, and Washington counties, was certified January 19 with special ceremonies at Bangor.

The tree farm, owned by the Dead River Co., of Bangor, is operated under a contractual arrangement by the Eastern Corp. Spruce, fir, hemlock, and hardwood pulpwood harvested on the tree farm is processed at Eastern's mills at South Brewer and Lincoln.

Harold H. Holden, president of Eastern Corp., and Curtis M. Hutchins, treasurer and principal owner of the Dead River Co., received certificates from Edwin L. Giddings, chairman of the Maine Tree Farm Committee at the Bangor ceremonies. Principal speakers included A. D. Nutting, Maine forest commissioner, and Charles L. Tebbe, regional forester for the U. S. Forest Service from Philadelphia.

Under an agreement, first entered into in 1947, harvests on the Dead River property are limited to three fourths of the annual growth. During the first 5 yr. of the agreement more than 50,000 cords of pulpwood and 10,000,000 board feet of logs were harvested.

The tree farm has been carefully inventoried, and permanent sample plots have been established. In addition to the forest protection system afforded by the Maine forestry district, the tree farm owners have supplied back pumps and two power pumps. Caches of hand tools have been established at strategic points around the property.

Slash has been removed from all operations bordering highways, property lines, and railroads. Logging operations are shut down on days of high fire risk and logging roads are closed. The initial 5-yr. cutting agreement between Dead River Co. and Eastern Corp. has been renewed for 10 yr. with cutting areas allocated 5 yr. at a time.

Forest Commissioner Nutting, in reviewing tree farm progress in the state since the program was launched last Autumn, said the campaign is giving "considerable encouragement to the application of better forest practices on privately owned timberlands in Maine."

Potlatch

Potlatch Forests, Inc., Lewiston, Idaho, is developing barking and chipping machinery for use in northern Idaho sawmills. The new machinery will be used to produce chips for Potlatch's pulp mill.

Production of paper at the pulp mill will be increased from 150 to 300 tons a day when the machinery is in use, company officials estimate. The project will cost Potlatch an estimated $1,000,000.

Packaging Exposition

The 22nd National Packaging Conference and Exposition of the American Management Association will be held at the Navy Pier, Chicago, Ill., on April 20–23, 1953.

Lowell Textile

The New England Paper Merchants Association has voted to renew its scholarship at the Lowell Textile Institute for the 1953–54 academic year. The scholarship is open to any upperclassman in the Paper Engineering Dept.

PCF

William D. Duryea II has joined the pulp sales staff of the Penobscot Chemical Fibre Co., Boston, Mass.

Bentner

The Benj. C. Bentner Co. of Devon, Pa., will hereafter operate as a division of the Continental Can Co., Inc., but under the same management and policies.

Storrs & Bement

The business of Storrs & Bement Co. and the Paper House of New England has been purchased by Carter, Rice & Co., an affiliate of Bulkley, Dunton & Co., New York.

Westinghouse

Thomas Fuller, Jr., has been appointed Manager of the Westinghouse new branch office at Atlanta, Ga.

The Westinghouse Lamp Div., Bloomfield, N. J., has issued a 25-page booklet on mercury-vapor lamps showing proper applications of both the fluorescent-mercury and straight mercury type lamps.

Cyanamid

The American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y., has issued a new booklet on "Alum" covering its history, its use in the paper and other industries, and alum handling systems. An interesting and useful publication.

Cyanamid is offering acrylic acid in trial-lot quantities for use as a paper finishing agent. A technical bulletin giving a review of the literature of the product is available.

E. D. Powers has been elected president of the Chemical Construction Co. He is vice-president of the American Cyanamid Co., North America Cyanamid Ltd., and the Arizona Chemical Co.

Becco

The Buffalo Electro-Chemical Co., Station B, Buffalo 7, N. Y., has issued a 19-page Becco Bulletin No. 34 on "Uses of Persulphates." The bulletin presents a bibliography of articles published dealing with the bleaching of cellulose.

Witco

Witco Chemical Co., 260 Madison Ave., New York 16, N. Y., has issued a useful data sheet in chart form on pigment blacks. It shows the color on the nigrometer scale, oil absorption, particle size, tinting strength, etc.

Sandusky

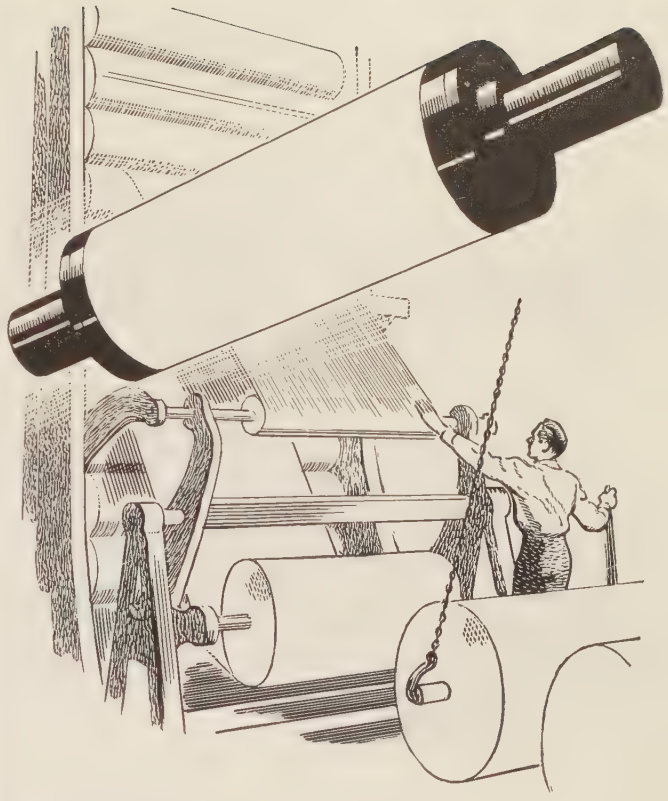
The Sandusky Foundry & Machine Co., Sandusky, Ohio, has issued a slide chart for rapidly calculating the water consumption of Sandusky showers under all normal paper mill operating conditions.

Morden Machines

Another outstanding sales year was chalked up in 1952 by Morden Machines Co. of Portland, Ore. The company manufactures stock preparation equipment, which includes "Slush-Makers" for pulping, "Stock-Makers" for beating, and "Stuff-Makers" for jordaning. It markets its products 'round the globe.

The company has approximately 700 "Stock-Maker" installations alone, and these have gone into 180 mills in 23 different countries. Nearly 100 of these installations were made in the last year. Through the years over half of the sales have been on repeat orders from previous customers.

Morden reports that the Orton Corp. of Fitchburg, Mass., the company's sales representative in the northeastern states, has had installations in the following mills during 1952: West Virginia Pulp and Paper Co., Williamsburg, Pa.; Fraser Paper, Ltd., Madawaska, Me.; S. D. Warren Co., Cumberland Mills, Me.; Hollingsworth & Vose Co., East Walpole, Mass.; American Writing Paper Corp., Holyoke, Mass.; Claremont Paper Mills, Claremont, N. H.; Eastern Corp., South Brewer, Me.; Tileston & Hollingsworth Co., Boston, Mass.; and Coy Paper Co., Claremont, N. H.



Profit-maker for your Mill

As the paper comes from the Calender stacks, you can notice the difference good calendering makes. Here at the stacks is your last opportunity to give your paper a competitive advantage.

If you are selling against the smooth, uniform surfaces produced by Butterworth Calender Rolls, why not use these long-life rolls yourself? Made to specification and tested for hardness, smoothness and density before delivery. Locked on the shaft under terrific pressure, they cannot slip. Will not come loose. Heads and shafts are of forged steel. Taper wedges are used.

Furnished new or refilled for every calendering need — coated, super, glassine, embossing. Let us quote on your requirements.

For full information, write or call H. W. Butterworth & Sons Company, Bethayres, Pennsylvania – 187 Westminster Street, Providence, R. I. : : 1211 Johnston Building, Charlotte, N. C.

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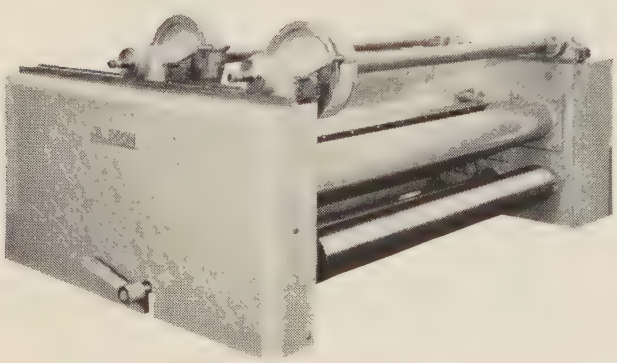
CALENDER ROLLS

Another

new machine from

WALDRON RESEARCH and ENGINEERING



The NEW Waldron AUTOMATIC UNROLL

Designed to answer the need for a rugged but relatively inexpensive automatic splicing unroll, this new machine will splice from 24 inch to 60 inch diameter bundles and features pushbutton operation. The bundle shafts are provided with a ball bearing side shift mechanism, and the cut-off knife can be manually or automatically controlled. The unwind can be used together with new equipment such as the WALDRON Microjet* for continuous high speed coating, or may be installed in line with existing equipment.
*Trade Mark Reg.

Full particulars and engineering details on all recent WALDRON developments will be promptly supplied upon request. Write us.

JOHN WALDRON CORP.

Leaders In Web Process Engineering Since 1827

NEW BRUNSWICK NEW JERSEY

Dan B. Chapman of Appleton, Wis., Sales Representative for Morden Machines Co., in the Midwest, has had installations in nine mills in that area.

Other "Stock-Maker" installations in 1952 were made on the West Coast, in Mexico, Israel, Japan, Brazil, Canada, England, France, Sweden, and Belgium. Morden is represented in Japan by W. E. Connor of Tokyo and in South America, by Parsons & Whittemore, Inc. Canadian "Stock-Makers" are manufactured by the William Kennedy & Sons, Ltd., Owen Sound, Ont., and European "Stock-Makers," by Millspaugh, Ltd., Sheffield, England. Both these firms are licensees of Morden for the "Stock-Maker."

The Morden Machine Co., Corbett Bldg., Portland 4, Ore., has issued a new leaflet, "The Morden Stuff-Maker for Jordaning."

American Polymer

American Resinous Chemicals Corp. and American Polymer Co. have appointed Schibley Solvents & Chemicals Co., 1940 E. 6th St., Cleveland 14, Ohio, as their sales agents for the state of Ohio.

Remington-Rand

Remington-Rand, Inc., 314 Fourth Ave., New York 10, N. Y., has issued a bulletin on its "Continuous Microfilm Enlargement Service."

D. J. Murray

Lawrence H. Lemke has been appointed General Superintendent of the D. J. Murray Mfg. Co., Wausau, Wis. Mr. Lemke started with Murray 27 yr. ago as a machine shop apprentice.

Allis-Chalmers

Allis-Chalmers Mfg. Co., 828 S. 70th St., Milwaukee, Wis., has issued a bulletin (20 B 7786) on its "High-Capacity Texrope V-Belts" for tight spots, oil resistance, and minimizing static.

Pennsalt

Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia 7, Pa., has introduced a new system of anticorrosion coating, using specially formulated neoprene coatings. The new system is claimed by Pennsalt's maintenance engineers to produce savings up to 50% per square foot in the maintenance painting and coating costs in the company plants. In the tests it was found that to stand up in service a coating has to be built up to a thickness of at least 5 mils, regardless of its corrosion resistance, and has to be especially effective in covering welds, beads, seams, and edges where coatings most frequently failed. It was found that it is uneconomical from labor and time standpoint, to apply more than three coats, including the primer. The new products Neoprime and Neocoat are formulated to attain the proper thickness within three coats.

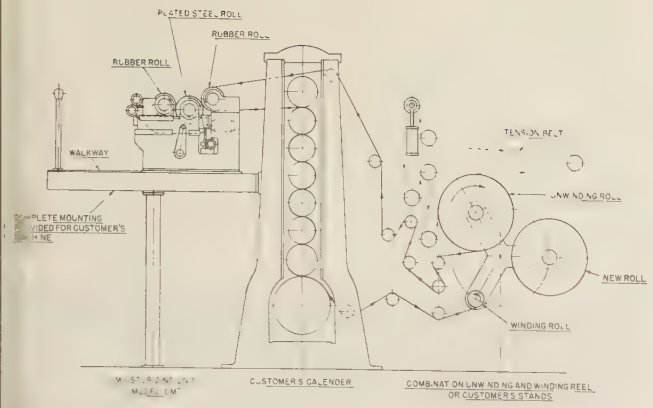
Albert E. Clem has been appointed Sales Manager for Pennsylvania Salt Mfg. Co., succeeding Russell S. Roeller deceased.

Black-Clawson (Shartle and Dilts)

A recent development that should be of more than passing interest to papermakers and converters is a means for eliminating separate operations required to add moisture to the sheet about to be calendered.

This machine known as the Dilts Moisture Applicator was developed by the Dilts Machine Works, Fulton, N. Y., Div. of The Black-Clawson Co., working in close collaboration with Waxide Paper Co. at St. Louis, Mo.

Mounted on the upper portion of the calender frames and driven by the top calender roll, this machine does the work then and there rather than elsewhere on the floor as a separate operation. In short this means "in line" moisture application and calendering.



Application of a Dilts moisture applicator to a calender

Designed for actual production speeds of 1000 f.p.m. on a [illegible]-lb. sulphite sheet this compact 3-roll self-contained unit is capable of applying controlled moisture between 9 to 11% maximum, down to as low as 3% minimum; maintaining a tolerance 0.5%. The machine is also capable of maintaining less than 0.5% variation across the full 52-in. web for which it was designed.

The Dilts Moisture Applicator offers the advantages of less web handling, hence less change of web breaks and subsequent waste. It was placed in operation with no sacrifice to calender speeds and is readily accessible for threading and quick cleanup.

Moisture applicator in operation at the Waxide Paper Co.

Particular credit for this outstanding "in line" moisture applicator unit goes to Waxide men Berry Dillon, Plant Manager; Kenneth Lannert, Plant Engineer; and Dilts' Sales Engineer, W. D. Haskell and Assistant Chief Engineer, R. W. Phelps. Full particulars are available from The Black-Clawson Co., Dilts Machine Works Div., Fulton, N. Y.

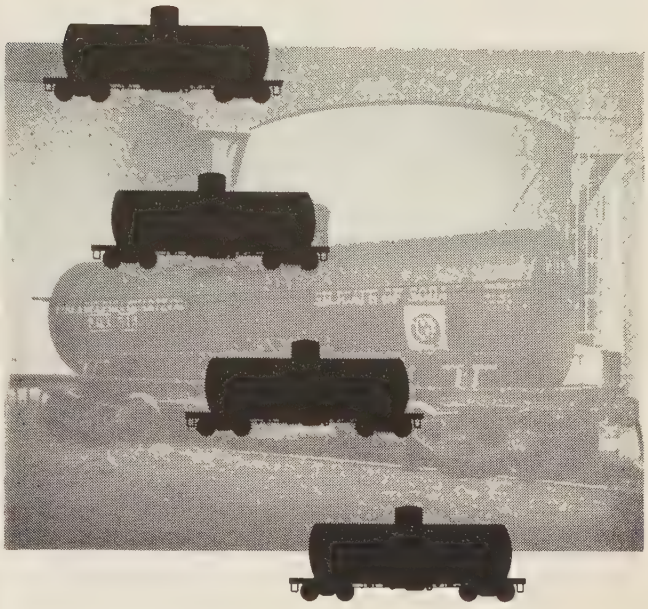
G.E.

The General Electric Co., Schenectady 5, N. Y., has issued three new bulletins: "Calrod Electric Heaters and Heating Devices" (G.E.C.-1005 D); "Low Voltage Drawout Switchgear" (G.E.A.-5915 and G.E.A.-5916); and "Photoelectric Recorder Applications" (G.E.A.-5536).

General Dyestuff

The General Dyestuff Corp., 435 Hudson St., New York 14, N. Y., has issued a new circular (G-737) on its "Fastusol Brown 3RL-CF for the Paper Trade." Samples of dyed bleached sulphite papers are shown.

PQ
Sodium Silicate



for Peroxide Bleaching

PQ's fleet of tank cars can keep you supplied quickly, efficiently. We will be glad to consult with you about suitable storage at your plant for either tank or drum deliveries. Request 17-E Bulletin, "Storage and distribution Systems for PQ Silicates of Soda".

Nine plants insure good delivery service. Manufacturing works located in: Anderson, Ind.; Baltimore, Md.; Buffalo, N.Y.; Chester, Pa.; Jeffersonville, Ind.; Kansas City, Kansas; Rahway, N.J.; St. Louis, Mo.; Utica, Ill.

Uniformly consistent quality protects your investment in peroxide. PQ Silicate properly controls Oxygen release and holds pH in the right range.

Philadelphia Quartz Company
1141 Public Ledger Bldg., Philadelphia 6, Pa.

PQ Silicates of Soda
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COMPLETE ENGINEERING AND CONSTRUCTION SERVICES FOR THE PULP AND PAPER INDUSTRY

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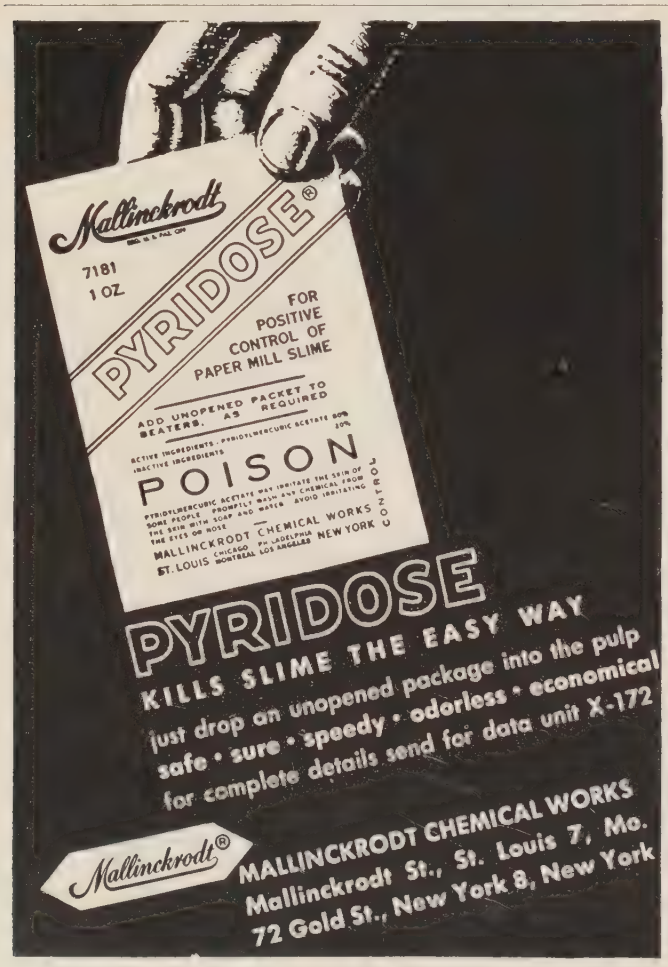
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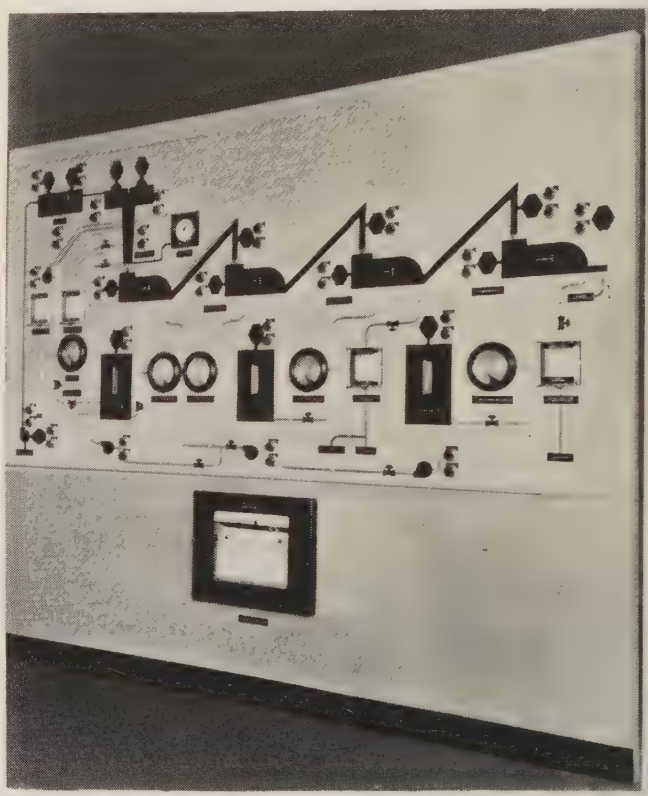
SUTHERLAND REFINER

A new type instrument panel shows the process flow on Sutherland Inc.'s pressure washing system. This single panel built by Minneapolis-Honeywell Regulator Co., Industrial Div., provides complete control, plus a permanent record on the entire operation of the four-stage pressure washing system. All four presses, every pump, the thickener, storage tanks, and blow tank pump are controlled by one operator from this single panel.



Control panel for the Sutherland Inc. pressure washing system

Complete process flow of pulp and countercurrent wash water are shown automatically on the panel board and all control switches and signal lights are placed on the panel showing its proper place in the system. Audio and visual alarms to signal overload on every motor can be installed if desired.

This is a complete process control that has been systematically laid out on an instrument panel to provide a visual indication of the exact spot of any possible failure. Location of difficulties and training of operating personnel are made easier and quicker.

Systems now in operation have established an enviable record for efficiency. Operating at a rate in excess of 300 tons per day, a four-stage system has consistently used less than 200 g.p.m. wash water with a dilution factor of less than 2 lb. water per lb. of stock, delivering a pulp containing less than 30 lb. salt cake per ton.

High-temperature operation and low wash water usage have resulted in high temperature, high solids content black liquor to the evaporators, thus reducing cost of evaporation.

LUKENS

The Lukens Steel Co., Coatesville, Pa., has issued a guidebook "Cleaning and Maintenance of Clad Steel Equipment."

JOHN W. BOLTON

The Fifth Bolton Award book containing 13 prize-winning essays on "Successful Selection of Supervisory Personnel"

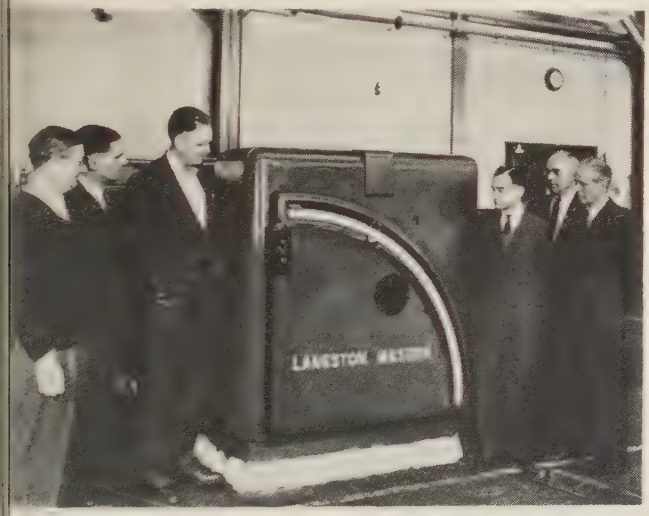
was recently delivered, but some copies were returned by the post office because labels became detached. If yours happened to be among those undelivered, write to John W. Bolton and Sons, Inc., Lawrence, Mass.

The Sixth Bolton Award contest is on the subject of "The Obligations of a Company to Its Employees." All entries must be mailed before midnight of March 31 to Secretary and Treasurer, The American Pulp and Paper Mill Superintendents Association, 111 W. Washington St., Chicago, Ill. This contest is open to all employees of North American Paper Mills, and $3250 in 13 cash prizes will be awarded. Copies of the contest rules may be obtained from The Superintendents Association in Chicago.

LANGSTON

Samuel M. Langston Co., Camden, N. J., manufacturers of corrugated container machinery, spiral tube winders, and slitters and roll winders has announced that Masson Scott & Co. Ltd., Riverside Rd., Summerstown, London S.W. 17, England, have just completed manufacture of the first English-built Langston Rotary Cut-Off. Masson Scott are well-known paper mill and converting machinery builders.

It will be recalled that some time ago Langston announced arrangements whereby their cut-off would be built in England to take care of a certain part of their foreign business. The sale of the English-built cut-off, as well as other Langston machinery, is handled in England, France, and Belgium by the Sheridan Machinery Co., Ltd., 52/54, High Holborn, London, W.C. 1, England.



E. Battersby and David Brand, Mason Scott; C. D. Nitchie, Langston; Hugh R. W. Marsh, Mason Scott; B. W. Langston; and G. E. Kempe, Sheridan Machinery Co.

Bryant W. Langston, president, and C. D. Nitchie, Chief Engineer, visited the Masson Scott plant in England recently to inspect the first cut-off, an 85-in. single rotary knife for Thompson & Norris Mfg. Co., Ltd. Other Masson Scott built Langston cut-offs for the United Kingdom will be shipped shortly.

SINDAR

At the annual meeting of the Board of Directors of The Givaudan Corp., E. R. Durrer was elected president of the company and its affiliate companies Givaudan-Delawanna, Inc., and Sindar Corp. Mr. Durrer succeeds Eric C. Kunz, who had retired from the active management of the company in 1947 when Mr. Durrer assumed the executive management in his capacity as executive vice-president. The other officers elected by the Board are: F. N. Bangs, vice-president and secretary; H. F. Duffy, treasurer; Max Luthy, vice-president

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EXPERIENCE: First manufacturer of satisfactory resilient Teflon packing in the U. S.

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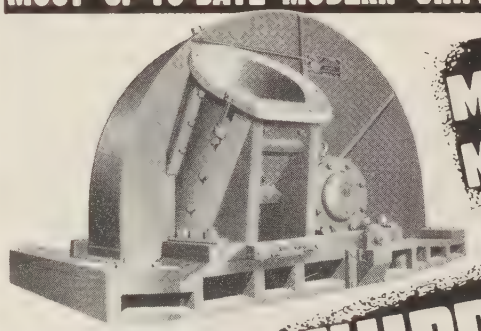
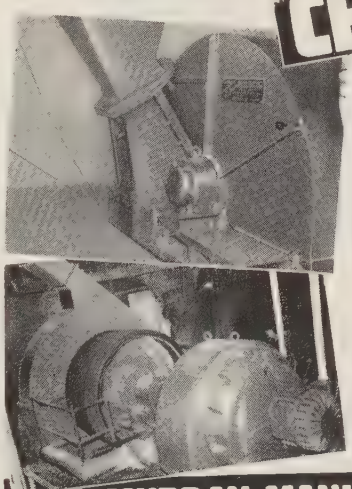
MOST UP-TO-DATE MODERN CHIPPER DESIGN



MURCO MULTIPLE KNIFE CHIPPERS



MURCO Multiple Knife Chippers are the result of careful study of the factors that contribute to outstanding performance . . . so that today, MURCO Chippers have excellent records of achievement, exceptional endurance, freedom from repairs, while providing better chips with less sawdust and less space. MURCO Chippers are heavy duty machines . . . that places their construction in a preferred class, and while ruggedly built, their simplicity of operation makes them most desirable for the daily demands for more and better chips at less cost in the up-to-date mill.

Made in standard sizes 50 to 120 inches (large sizes for special installation). These features are important to the mill operator . . . check our latest machines:

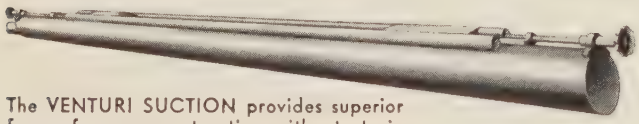
Uniform chips — Minimum sawdust
Fewer slivers
Production records of 100 cords and over per hour.
Heavy design and rigid construction reduces vibration.
Low maintenance.

D. J. MURRAY MANUFACTURING CO.
WAUSAU Manufacturers Since 1883 WISCONSIN

Prolong FELT Life with SCOFIELD Equipment

Reduce *felt costs* . . . be assured of thorough, efficient, economical cleaning of felts with a minimum of shutdowns.

The SCOFIELD AUTOMATIC FELT CONDITIONER eliminates fill-ups; insures greater uniformity, by removing destructive substances from felts. Keeps felts clean and soft, reduces shower water consumption, pays for itself in savings



The VENTURI SUCTION provides superior form of vacuum extraction without strain on felt. It removes more water with low vacuum, preserves felt, reduces costs.

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Associated with Canadian Vickers, Ltd., Montreal, Builders of Sandy Hill Designed Machinery in Canada

Motor Driven Model A Tester With Hydraulic Clamping Device

Especially designed for testing corrugated container board. Larger clamping area and reproducible clamping at any desired pressure eliminates crushing and slippage of the sample.

Write today for prices on these new testers, also the cost of converting your present Model A machines.

B. F. PERKINS & SON, INC.

Holyoke, Massachusetts

in charge of production and research; and R. E. Horsey, vice-president in charge of sales. R. E. Vicklund continues as Manager of Sales and Development of Sindar Corp.

National Starch

The U. S. Navy has awarded National Starch Products, Inc. a contract for "further research and development work to produce an improved adhesive for the bonding of palletized unit loads; to make a study and evaluate the acceptability of adhesives now being manufactured for palletizing; and to investigate and develop improved methods of adhesive application so as to extend the use by Armed Services and industry of this efficient method of handling and shipping supplies."

Palletizing with National's Load-Loc No. 4 adhesive and other glues provided the answer to the World War II shortage of steel strapping for holding individual units on pallets, in shipping and in materials handling.

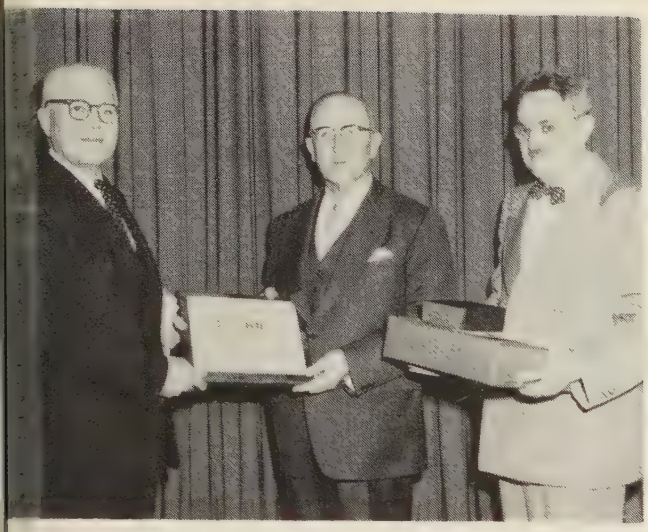
In seeking an alternative method which would involve no critical materials or skilled labor, government agencies found that this new method is the lowest cost method of insuring stable pallet loads and still meeting these requirements. In addition, the process is fast and saves material and space.

Bulkley, Dunton

Bulkley, Dunton Processes, Inc., has expanded its personnel and office facilities throughout the United States, according to an announcement by O. F. Hutchinson, recently appointed vice-president of the company.

Among the additions to the company are George Hurst, with offices at 2335 Charlestown, Toledo, Ohio, and Ralph Berman, with offices at 1605 E. 50th St., Chicago 15, Ill., C. P. Ryan, formerly of Bechtel Corp., has joined the Bulkley, Dunton Processes, Inc., Pacific Coast offices in Pasadena, Calif., and J. Dermody, formerly of the U. S. Public Health Service, has been appointed resident engineer at the company's main office in New York City.

Bulkley, Dunton Processes, Inc., executives

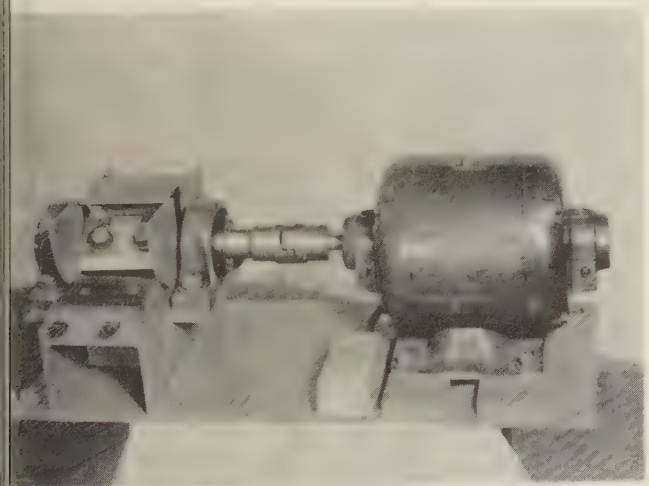


Alumni of the University of Maine and the New York State College of Forestry honored Professor C. E. Libby (center) at a joint luncheon in New York on Feb. 18. J. L. Ober, vice president of the Scott Paper Co., (left) is shown presenting Professor Libby with the U. of M. Pulp and Paper Foundation's Honor Award, while William R. Willets, of the Titanium Pigment Co. is shown presenting Professor Libby with several gifts from NYSCF alumni including a set of rare Japanese handmade papers

Coincident with this expansion in personnel, Executive Vice-President R. A. Baum has announced the development of the Flotair Cylindrical Saveall, companion equipment to the Colloidair Flotation Saveall. Other new developments include efficient trickling filter methods and allied equipment for the complete treatment of waste water.

TAYLOR-STILES

Taylor-Stiles & Co., Riegelsville, N. J., has announced a new trim cutting machine. These small motor-driven cutters are designed to receive edge-trims as they come from slitting machines and cut the trims into lengths suitable for removal by air conveyors or similar means of disposal. Two of these



The new Taylor-Stiles & Co. trim cutting machine

small cutters are usually placed, one on each side of the slitting machine, operated by a single shaft and on one small motor, or each trim cutter may have its individual motor.

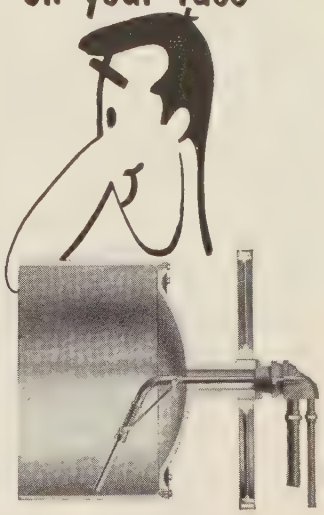
RELIANCE

Dale D. Drollinger has been appointed Manager of the Rockford, Ill., branch office of the Reliance Electric & Engineering Co. of Cleveland, Ohio.

Reaction of ¾" Auto-Flex in 48" dia. dryer. Very low leverage.

Reaction of ¾" ordinary bent pipe. Syphon in 48" dia. dryer. High leverage.

as plain as the nose on your face



The above cuts and captions tell the Midwest Auto-flex Syphon story—and it's as plain as the nose on your face.

End of pipe takes correct position and cannot possibly change its position. That means proper water and air removal. Reduced leverage, compared to other syphon pipes, permits the "pipe" to clear and stay clear of the journal. And that means freedom from wear, hence far longer life.

Thousands of Midwest Auto-Flex Syphons in use and doing fine. A dozen orders from you would prove all claims and makes you an Auto-flex booster. Remember, they're fully guaranteed.

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When you need

Gelling agents
Asphaltic products for lamination
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Stearates for water-resistance and plasticization

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. . . for a pure, uniform product
. . . for quick, friendly service
. . . for expert technical assistance

Witco products, manufactured in our own modern plants under strictest quality control, are *job-designed* to meet your needs. A note to any of Witco's offices will command our instant attention. Write today.

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Head table at luncheon honoring Professor Libby—Professor C. E. Libby, a graduate of the University of Maine, retired head of the New York State College of Forestry's pulp and paper department, and present head of the newly established department of papermaking in the School of Forestry at North Carolina State College of Agriculture and Engineering, was honored February 18 by Maine and NYSCF alumni in New York. Those at the head table for the luncheon were, front row left to right: K. P. Geohegan, Howard Paper Mills, Inc., Aetna Paper Co. Div., Dayton, Ohio; William R. Willets, Titanium Pigments Corp., New York, N. Y.; Clark E. Snook, Nopco Chemical Co., Harrison, N. J.; Marsden C. Hutchins, Johns Manville Co., Boundbrook, N. J.; Professor C. Earl Libby, Head of Pulp and Paper Technology, North Carolina State College Raleigh, N. C.; Everett K. Mansfield, Ellis Paperboard Products, Inc., Thompson's Point, Portland, Me.; J. L. Ober, Scott Paper Co., Chester, Pa.

Second row, left to right: Chancellor William P. Tolley, Syracuse University, Syracuse, N. Y.; Ralph David, Pulp & Paper New York, N. Y.; Floyd C. Peterson, Dow Chemical Co., Midland, Mich.; Dr. Edwin C. Jahn, State College of Forestry Syracuse, N. Y.; Frederick H. Flaherty, N. Y. State College of Forestry Alumni Assn.; Harry E. Weston, American Pulp & Paper Mill Superintendents Assn., Chicago, Ill.; Douglas Jones, Technical Section, Canadian Pulp & Paper Assn., Montreal P. Q., Can.; Raymond S. Hatch, Hudson Pulp & Paper Co., Palatka, Fla.; Professor Frederic W. O'Neil, State College of Forestry, Syracuse, N. Y.; Dean Walter J. Peterson, North Carolina State College, Raleigh, N. C.

Johnson Corp.

A new attempt to simplify the problem of liquid level control has been announced by the Johnson Corp., Three Rivers, Mich., makers of steam specialties and boiler room equipment. In operation, two stationary electrodes are suspended in the tank where a circuit between the two is established or broken by the rising or falling of the liquid level. This circuit actuates the relay which, in turn, operates the solenoid valve. This valve may be installed in either the tank supply or the discharge line, whichever operating conditions require for proper level control.

Texaco

The Texas Co., 135 E. 42nd St., New York 17, N. Y., has issued as its March, 1953, issued of *Lubrication*, vol. 39, No. 3, 44 pages devoted to "Paper Mill Lubrication."

Huyck Felts

Frederic A. Soderberg has been appointed vice-president of F. C. Huyck & Sons in charge of sales for the papermaker felts and mechanical fabrics division. Mr. Soderberg was formerly Manager of the Industrial Division of The General Dyestuff Corp.

Rohm & Haas

Rohm & Haas Co. has recently completed and put into operation a new plant for the production of acrylic monomers, raw materials used to make the company's Rhoplex and Acryloid resins for coatings. The new 8 million dollar plant is located at Deer Park, near Houston, Tex. The raw materials are petrochemicals, including acetylene, carbon monoxide, and various alcohols. The Acryloid resins are used in nonyellowing coatings for playing cards and chemically resistant paints.

Mason-Neilan

John W. Brown has been appointed Manager of the new Seattle, Wash., office of the Mason-Neilan Regulator Co., located in the Dexter-Horton Building.

R. B. MacMullin

R. B. MacMullin Associates, 43 Falls St., Niagara Falls, N. Y., has issued a Summary Report of Its Activities, prepared for executives in the chemical industries.

Chemical Linings

T. E. Detcher has been appointed vice-president in charge of engineering of Chemical Linings, Inc., Watertown, N. Y. Mr. Detcher, a 1941 graduate of Clarkson College of Technology, was formerly with G. D. Jenssen Co. and was Assistant Sales Manager of the Nitrogen Div. of Allied Chemical & Dye Corp. where he helped to develop the ammonia-base sulphite process. Murray Bennett, president of Chemical Linings, Inc., has announced expansion of

J. W. Brown, Mason-Neilan Regulator Co.

F. A. Soderberg, F. C. Huyck & Sons

T. E. Detcher, Chemical Linings, Inc.

ne company facilities to serve the pulp, paper, and chemical dustries.

FOXBORO

A new technical information sheet (TI 33-A-68a) has been sued by the Foxboro Co., Foxboro, Mass., covering the peration of its Model 40 Elapsed Time Controllers, which utomatically control the measured variable (temperature, essure, etc.) at the desired value for a preset period of time. his type of control has wide application in the paper indus- y when process time is a vital factor. A data sheet 260-17 n "Paper Machine Remote Stuff Gate Positioning" has been sued by Foxboro Co.

HYDROTESTER

H. A. Brenner, president, has announced the founding of a Hydrotester, Inc., at 101 Henry St., Brooklyn 1, N. Y. This pany will act as the distributing agent for Paul Lippke, Iowied, West Germany. The equipment is used for the ng and regulation of moisture, basis-weight, and thick- of paper.

OBITUARY

Don L. Quinn

Don L. Quinn, President of the Don L. Quinn Co. Testing Laboratories, Chicago, Ill., died of a heart attack on Feb. 26, 1953, at Presbyterian Hospital, Oak Park, Ill.

Mr. Quinn was born at Decatur, Ind., on Oct. 4, 1875. He started work in the employ of the Chicago Mill & Lumber Co. in Chicago where he engaged in research work for 18 years. He was in charge of the Box Testing Section of the U. S. Forest Products Laboratory at Madison, Wis., for 2 years and for the past 30 years has conducted his own box testing laboratory in Chicago.

He has been a member of the Technical Association of the Pulp and Paper Industry since 1936, at one time serving as chairman of the TAPPI Container Testing Committee.

He is survived by his widow, June, a daughter, Louise Quinn Forman, of Glencoe, Ill., and a grandson. His body was interred at Decatur, Ind.

RECENT BOOKS

Radioisotopes in Industry. Edited by John R. Bradford, Case Institute of Technology. Reinhold Publishing Corp., New York, 1953. Cloth, 5 × 9, 400 pages. $8.00.

This book is based on a series of lectures presented at the Case Institute of Technology and covers the important industrial uses of radioactive isotopes. It contains a minimum of mathematical treatment and is of particular interest to physicists, engineers, and research men.

Each chapter is written by an expert in his field and covers such subjects as fundamentals of radiochemistry, radiation protection, uses of isotopes in physical and chemical research, application of radioisotope techniques, tracer experiments, and instrumentation. Several items relate to the measurement of thickness.

Crime Investigation. Physical Evidence and the Police Laboratory. By Paul L. Kirk, University of California. Interscience Publishers, Inc., New York, 1953. Cloth, 6 × 9, 806 pages, 161 illustrations. $10.

A survey of the field of science and technology of crime investigation. Since much of the book deals with physical evidence attention is paid to microscopical methods.

There are a number of items related to paper fibers, bags, envelopes, packaging, and surfaces. Special consideration is given to documents of all kinds, handwriting, etc., photography. Quick methods of determining the elements are reviewed. It is an interesting book even for readers not interested in the details of criminology.

Glycerol. By Carl S. Miner, Miner Laboratories, and N. W. Dalton, Glycerine Products Association of America. Reinhold Publishing Corp., New York, 1953. Cloth, 6 × 9, 470 pages. $12.

American Chemical Society Monograph No. 117 deals with the sources, recovery, refining, specifications, analyses, properties, and uses of glycerol. Several specialists collaborated in the preparation of the text. Reference is made to uses in emulsifiers, resins, cellophane, and paper as a plasticizer.

Encyclopedia of Chemical Reactions. Vol. V. Edited by the late C. A. Jacobson of West Virginia University. Reinhold Publishing Corp., New York, 1953. Cloth, 6 × 9, 787 pages. $15.

Previous volumes of the Encyclopedia have been reviewed in *Tappi*. Volume V covers the elements alphabetically from Nickel to Ruthenium, inclusive. The Encyclopedia should be a part of every research and testing library since it eliminates the necessity of working out chemical reaction equations with possible errors. Almost every kind of a reaction is illustrated by equations, giving authoritative source of such information.

Chemical Analysis of Industrial Solvents. By Morris B. Jacobs, New York City Department of Health, and Leapold Sheflan of Tel Aviv, Israel. Interscience Publishers, Inc., New York, 1953. Cloth, 6 × 9, 501 pages. $10.

This book is a textbook for chemists dealing with the use of solvents of any kind. A thorough treatment is given of such subjects as sampling, physical and general methods, physical-chemical methods, methods of analyzing mixtures, paraffin, and turpentine, glycols, acids, and estus, ketones and aldehydos, nitrogen and sulphur compounds.

Polysaccharide Chemistry. By Roy L. Whistler and Charles L. Smart, Purdue University. Academic Press, Inc., New York, 1953. Cloth, 6 × 9, 493 pages. $10.80.

An outline of the present status of knowledge regarding the structure of high polymers of the carbohydrate type. Considerable attention is given to cellulose, hemicelluloses, mannans, pectic substances, galactans, starches, gums. It is of great value to research men in the pulp and paper industry.

Note: The books reviewed in this section may be obtained through the Recent Books Department of the Technical Association of the Pulp and Paper Industry, 122 E. 42nd St., New York 17, N. Y.

LETTERS TO THE EDITORS

Harnden-McLaurin Test (T 463 m-52)

To the Editor, *Tappi:*

The tentative standard T 463 m-52, as adopted by the Standards Committee of the Technical Association of the Pulp and Paper Industry, states that, "the test results are indicative of how well the tape will adhere and whether it will adhere with satisfactory rapidity in the sealing operations."

For reasons to be brought out in this discussion, the standard should rather read, "the test results supply a comparative record of how well and how quickly various tapes adhere to a standard kraft paper surface under the conditions and operations of this test." This is as much as can be determined by the Harnden-McLaurin instrument in the testing of the adhesiveness of gummed tape. The test results as obtained, cannot be correlated to actual usage and application of gummed tape in the field, but rather their interpretation must be confined to the instrument in use, and to those instruments which duplicate its degree of automaticity.

It is understood certainly, that no one instrument designed to test a quality or property of a product, can be expected to be versatile enough to reproduce all the variable conditions of use and application existing for that product. However, after a decision is made as to what property or quality of a product is to be tested, then the next step obviously, is to determine how it can be tested most effectively so as to simulate as closely as possible its varying commercial uses and applications. Because of this, it is my belief that the Harnden-McLaurin instrument does not supply the best means of testing for the adhesiveness of gummed paper tape. (It is not the intent of this discussion to evaluate or criticize the operational merits of the instrument, such as the hand dispensing of tape samples, and the placement (centering) of the samples on the test surface by hand.

My reasoning in support of this statement, is this.* Essentially, a measure of the adhesiveness of gummed paper tape, as defined in the standard, consists of a measure of its wet tack. Tack as defined by Committee D-14 of ASTM, is the property of a material measurable as the pull resistance to effect division without failure or deformation in the adherends, while the adhesive exhibits viscous or plastic flow. Tack, according to J. Hoekstra and C. P. Fritzius, is a pull resistance caused by the flow-resisting properties of the adhesive, yield value, and viscosity, influenced to a certain extent by the surface tension. They mention also that the whole phenomenon of tack or tackiness can be considered to be a rheological phenomenon, and as such, must be considered in terms of force, time, and deformation, and in the relationship of these terms.

The Harnden-McLaurin instrument, as presently designed, attempts to measure the tackiness of the adhesive according to definition, by applying a known force almost instantaneously and measuring on a scale the pull resistance or deformation of the liquid adhesive. For the tackiness of the adhesive will resist relative movements of the adherends (test surface and paper backing of the tape) both in normal and tangential directions, if these movements are not too slow. The pull resistance of the liquid adhesive will counteract the separating force, and can be measurable providing no rupture takes place in the adherends. However, should rupture or deformation occur in the adherends, whether it be due to the excessive force applied, the time in which the force is acting, or due to excessive pull resistance of the liquid adhesive, there no longer exists a favorable balance of force, time, and deformation, and the value of tack obtained cannot be considered to be a measure of adhesiveness. The statement may be made that rupture occurred in the adherends because the liquid adhesive adhered too quickly, or more quickly than another adhesive, and therefore we have a measure of comparison between the two. This is in effect saying, that one adhesive exerts a greater pull resistance than the other, either because of higher yield value, adhesion or cohesion of the adhesive, or lower viscosity and surface tension. However, if either the separating force or the time of application of the separating force, was decreased, the relationship of pull resistance between the two adhesives above would change entirely. These are some of the complex problems involved when an attempt is made to measure the pull resistance of a liquid adhesive, such as is made with the Harnden-McLaurin instrument.

For example, tests made by R. S. Rivlin (*1*), on adhesive surgery plaster attached to a stainless steel plate supply evidence of the complexity involved in measuring the pull resistance of an adhesive. He speaks of it as the effective work of adhesion and says that it varies with the speed at which the stripping of the tape is carried out. The graphical presentation of his data shows that for short times of stripping the effective work of adhesion is very sensitive to variations of the stripping time. On the other hand, for relatively long times of stripping, the effective work of adhesion is not greatly dependent on the stripping time. Cannot this be interpreted to apply to the operation of the Harnden-McLaurin instrument? The tripping of the platens and consequent time of application of the separating force are a constant and almost instantaneous time interval, and for this reason become a very important factor. For at this time of application, the pull resistance is extremely sensitive to variations in time. It becomes analogous to the difference between a force and a blow. Would not a test be more suitable in which the force applied in separating two solid layers between which there is liquid adhesive were extended over a longer period of time. The value obtained for pull resistance would then be independent of time. In other words, a more suitable test would measure the speed of adhesion, rather than the effective work of adhesion or pull resistance of the liquid adhesive.

Experiments made with "Scotch" brand transparent tape applied to cellulose acetate, glassine, and cellophane surfaces, illustrate even more the importance of the time factor of rate of separation and its influence on the values of the separating force (*2*). The results indicated that at low rates of removal, the separating forces on cellulose acetate and glassine are nearly equal. At higher rates of removal, however, the value increases rapidly for cellulose acetate, while the value for glassine changes but little. Also at low rates of removal, the value of the separating force from cellophane is very low, but increases rapidly to quite a high value as the rate of removal is increased (*3*).

Inasmuch as these considerations of force, time, and deformation point out the inapplicability of the Harnden-McLaurin instrument as the best means for testing the adhesiveness of gummed tape, the problem of "short" and "long" adhesives must also be considered. Adhesives generally termed "short," have a high yield value and low viscosity, which immediately tend to prevent the deformation of a joint. When testing this type of adhesive on the Harnden-McLaurin instrument, a high value would be obtained. "Long" adhesives, however, with no yield value at moderate shearing stresses, but characterized by high viscosities, form long threads. This type of adhesive would tend to put up less resistance to the deformation of a joint, resulting in a lower test on the Harnden-McLaurin instrument. Actually, however, the high yield value of short adhesives is not conducive to penetration

* Reference is made to the book "Adhesion and Adhesives," edited by DeBruyne and Houwink, and to Chapter 3 by J. Hoekstra and C. P. Fritzius from which most of the discussion presented here is reproduced. The reader is urged to review this chapter.

into porous substances, therefore a higher strength is claimed for the long adhesives. Their high viscosity also promotes greater adhesive strength. These considerations would tend to contradict the results as obtained on the Harnden-McLaurin instrument.

On the basis of the aforegoing I arrive at the following conclusions:

The resistance to the separation of two solid layers, between which there is a liquid adhesive, depends on the rate of separation, and therefore there isn't one definite force which opposes the breaking of a joint. In addition, since the resistance increases inversely to the time, if the time is very short, or if a joint is separated by a sudden separating force, the force or resistance of the adhesive layer may become greater than the tensile or initial tear strength of the adherends, and hence they are ruptured, rather than the adhesive layer.

Unless the Harnden-McLaurin instrument can be modified so as to exert a much less separating force over a greater period of time, in which case the effects of force and time on the pull resistance of the liquid adhesive would be minimized, it should not be considered as the standard test instrument for determining the adhesiveness of gummed tape. The test results obtained would apply only to the conditions of force, time, and deformation as they are related in the instrument. And as was pointed out in this discussion, the relationship of these terms in the instrument are directly opposite to the conditions considered favorable for determining the effective work of adhesion or pull resistance of the liquid adhesive. Therefore the test results are highly questionable.

In conclusion, the writer would like to add a personal note. It would seem to me, that the best means of measuring the adhesiveness of gummed tape, is not with an instrument that attempts to measure the pull resistance or the force needed to effect separation, etc. These are ambiguous terms, not well enough understood, which are dependent upon too many variable factors. Test results obtained in this manner can never be correlated with commercial usage and application, or how can one know what separating force the flaps of a carton container will exert upon the tape used to seal them closed, and how can one know what the rate of separation will be.

A superior and more sure means of testing the adhesiveness of gummed tape, would be to test its time of set or speed of adhesion, or to measure the time interval between moistening of the tape and the instant the tape tears a good percentage of fibers from the test surface. Call it what you will, it is a test of time, rather than force. An instrument of this kind is not dependent upon the separating force or the rate of separation, for they can be kept low enough to the point of being insignificant, or they can be varied at will.

Without attempting to offer a full explanation at this time, may also add that beginning more than two years ago, our efforts here at Central Paper Co. have been concentrated in developing an instrument that would test the speed of adhesion of gummed tape, and we have been successful in developing such an instrument. Because we are of the belief that the Harnden-McLaurin instrument does not offer the best means for testing the adhesiveness of gummed tape, we wish to place our instrument at the hands of those who share the same belief, so that together we may cooperatively evaluate its merits.

References

1. Rivlin, R. S., *Paint Technology* 9: 218 (1944).
2. Hendricks, J. O., Linden, G. F., and Wehmer, F. J., *Rubber Age (London)* 32: 327 (1948).
3. *Aero Research Technical Notes, Bulletin No. 24* (Dec., 1944) issued by Aero Research Ltd. Duxford, Cambridge, England.

R. C. Williams
Central Paper Co., Menasha, Wis.

Fourdrinier Wire Sales Representative

Manufacturer of fourdrinier wires in Western Germany wishes to communicate with prospective sales representatives who are thoroughly acquainted with the pulp and paper companies of the United States of America.

The plant is equipped with very modern machines and has a considerable output. It produces all kinds of fourdrinier wires in all dimensions; heavy fourdrinier wires with polished surface in any length and up to a width of 8500 mm. (27 ft. 11 in.) for printing and fine paper manufacture.

Detailed inquiries from interested individuals or firms are requested. Please write

Messers. MAPREMA, Soc. Anon., 7, rue. du Luxembourg, Bruxelles, Belgium.

Ed. Note: Individuals experienced in the field of gummed tape testing are urged to express their views to the Editor of *Tappi* concerning the adequacy of the Harnden-McLaurin test, as it is popularly known. Individuals interested in cooperating with Mr. Williams in studying the instrument to which he refers should write to him and report results obtained to the Editor of *Tappi* for publication for the benefit of manufacturers and users of gummed tape.

EMPLOYMENT SERVICE

Positions Wanted

E188-52. Mill Manager desires change. Capable of taking full charge of operations as Manager or equivalent executive position. Broad practical experience in the manufacture of papers, medium quality boards, production of kraft, sulphite, and groundwood pulps and paper and converted products. Engineering graduate.

E217-53. Container Superintendent and former Division Chemist with 12 yrs. experience in board mills and converting plants. Now employed. Desires comparable position with a progressive company. Will consider production, sales, or technical position.

E219-53. Pulp and Paper Chemist. 28. Married. B.S. (1947). Five years' experience pilot plant and development work. Desires employment in Gulf States area.

E220-53. Technical Director or Technical Sales. Graduate Chemist. Married. Seventeen years' varied experience in testing pulp, paper, and textiles. Can handle variety of technical and research problems.

E221-53. Graduate Paper Chemist. Five years' experience in quality control, research, and production. Desires position with a paper converter or in an allied field.

E222-53. Man past 50 with life-long experience in the manufacture of fine papers, seeks position as manager or superintendent. Experience covers every position in the mill and includes ten years with one of America's finest mills. Good educational background.

E223-53. Wood and Pulp Technologist. Ph.D. Broad administrative research and development experience in pulp and paper, new process fiber and particle boards, wood plastics and adhesives, and chemical utilization of waste. Patents and publications.

E224-53. Manager, Superintendent, or equivalent capacity. Pulp and paper school graduate. 24 years' experience of technical and practical experience in pulp, paper, and paper twisting. Considerable operating, field work, and supervisory experience with kraft mills and twisting converters. Present salary $12,000, as supervisor of paper twisting plant.

E225–53. Graduate Mechanical Engineer, 27. Single. Three years' experience in chemical, newsprint, and plastic plants. Canadian. Desires to locate in the United States.

Positions Open

P250-53. An opening exists in the technical staff of midwest mills producing board and corrugating medium. Applicant should be under 35 and have an academic background of chemical engineering or pulp and paper. Unless a '52 graduate, mill experience will be valuable. After a brief training, the man employed will be placed in charge of mill laboratory. Send detailed application with photograph.

P284-53. Chemical Engineer. Excellent opportunity for a young graduate engineer with several years' experience or equivalent graduate study, in a newly established technical department of a modern kraft liner board mill. Duties will involve design, process analysis, and pilot work. Chances for advancement are excellent. Location southeast. Please give details in first letter. All replies held in strictest confidence.

P291-53. Technical Salesman. Progressive manufacturing concern desires aggressive individual with several years' paper mill experience. Technical background essential. Requires travel in New York State. Send complete information on education, experience, and salary desired.

P292-53. A well-established specialty paper manufacturer located in the Philadelphia area is looking for a graduate mechanical engineer between 28–35 years of age. The position to be filled is that of assistant to the superintendent of the Mechanical Department, who is looking forward toward retirement within the next five years. In reply, give complete background of education and experience with salary requirements.

P293-53. Recent papermaking or chemical engineering graduate with some technical experience in paper desirable. Man selected will be responsible for new product and process development work as a member of the New Product Development Staff of a well-established paper manufacturer. Excellent opportunity exists for advancement. This company is located in the Philadelphia, Pa., area. In reply, give complete background of education and experience along with salary requirements.

P294-53. Paper Chemist for important supervisory work in large research and development laboratory. Prefer Ph.D. with paper industry experience and good chemical background. Please send details of education and experience.

Note: Responses to Positions Wanted and Positions Open should be sent to the Technical Association of the Pulp and Paper Industry, 122 E. 42nd St., New York 17, N. Y.

WANTED: RESEARCH CHEMIST

Immediate opening in research and development department of specialty paper manufacturer. Excellent opportunity for young man with initiative and imagination. Experience or background in paper technology and resins desirable but not essential. In first letter give complete resume of experience, age, education, and present salary. Address Technical Director, Hollingsworth & Vose Co., East Walpole, Mass.

WANTED: CORRUGATED TECHNICAL REPRESENTATIVE

National manufacturer of materials used in corrugated board has a sales opening for young man experienced in manufacture of corrugated paper. Must be qualified to give technical assistance to customers. Commensurate salary; Permanent job; Midwest location. All replies confidential. Reply to TAPPI, 280-53. Technical Association of the Pulp and Paper Industry, 122 E. 42nd. St., New York 17, N. Y.

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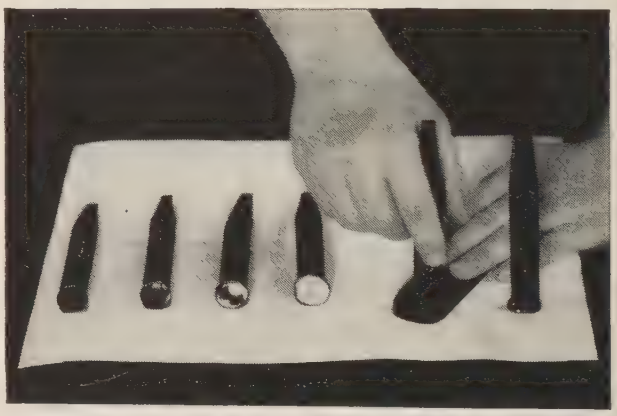
You'll save time, money and headaches on any printing job by pre-run testing of the paper. For real help in predicting the behavior of stock on the press use DENNISON STANDARD PAPER TESTING WAXES. The graduated adhesive properties of these waxes provide you with working estimates of coating pick and bodystock strength.

Constant laboratory control and exacting standards of manufacture make these waxes a reliable measuring instrument.

For a pamphlet giving details of DENNISON STANDARD PAPER TESTING WAXES, write Dennison Manufacturing Company, Dept. T, Framingham, Massachusetts.



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STANDARD

PAPER TESTING WAXES

LOCAL SECTION ACTIVITIES

Reports of Meetings, Personnel, and Events

Ohio

The Ohio Section met at the Hotel Manchester on February 10. Francis J. Curtis, Vice-President of the Monsanto Chemical Co., St. Louis, Mo., talked on "More and Better Research" before a record attendance of 250 members and guests of the Section. Mr. Curtis' talk is published elsewhere in this issue of *Tappi*.

The March 10 meeting of the Ohio Section attracted 101 members and guests to an instructive and serious evening at the Hotel Manchester in Middletown, Ohio.

Chairman Ed Brandon appointed P. S. Cade chairman of the Nominating Committee and asked H. A. Smith and Don Jenkins to assist in nominating a slate of officers to give the Ohio Section an efficient and progressive administration in the coming year.

Harold C. Koch, chairman of the Routine Control Methods Committee, requested the cooperation of all members in sending in well-written descriptions of Routine Control Methods they had found effective.

J. Edward Todd of The Institute of Paper Chemistry, Appleton, Wis., spoke on "The Selection of Technical Personnel." He opened his talk by quoting the March 10, 1953 issue of "Ohio Tappi" as follows: "Competition, greater production, higher speeds, and customer demands are but a few of the many factors tending to place more emphasis on the need for technical personnel in the paper mill. With this growing accent on technology, the proper evaluation of the potential of applicants for technical employment has become an increasingly acute problem. This problem is felt more by the smaller mills, however, than by the larger since they have not had the means nor capacity to employ personnel trained for this hiring job."

Signing up new personnel is more difficult than it sounds and it is customary for the employer to expect more than he gets, human nature being infinitely complex and unpredictably dynamic.

Since 1949 the industries which have grown most rapidly in their order of growth are natural gas, aluminum, paper, and the chemical mineral groups. The paper industry has doubled since 1949 and now is making annual sales of eight billion dollars from plants valued at six billion dollars.

The rapid growth which has been experienced is largely due to the impact of scientific knowledge in solving the problems of the industry accompanied by a wide national prosperity.

Management has therefore come to a realization of the importance of supplying their organizations with trained technical man power and the business of recruiting them from the ranks of college graduates has become a very serious and highly competitive enterprise. This hunt for superior technical manpower has become more intense because where there were 45,000 to 50,000 engineering graduates 2 to 3 years ago there will only be 20,000 available this year to fill an estimated 70,000 to 75,000 openings, so that only a third of the men needed will be employed. One organization has recently recruited 90 men from European universities but only time can tell whether this will be a good solution of the problem. There now seems to be an uptrend in registrations for college freshmen in engineering and technical courses for next Fall but it will take four years before industry can hope to use these men. There is also increased interest among graduates in specialized training as evidenced by the fact that the next first year class at The Institute of Paper Chemistry will be double the size of this year's class.

What does industry look for in the men they are recruiting? George Bennett, president of Psychological Corp., says "Some of the qualities considered essential to research personnel (and technical personnel) which might distinguish them from salesmen, administrators, production supervisors, and others in industrial activities are:

1. Knowledge of the scientific field.
2. Superior intelligence.
3. Ability to write reports and speak well.
4. Ability to produce new ideas—imagination.
5. Persistence in the face of difficulty.
6. Curiosity and a desire to solve problems.
7. Possession of certain character traits including honesty generosity, self discipline, courage, and tolerance.
8. Attitude toward work.
9. Ability to analyze and develop an organized attack on the problem, rather than dependence upon an inspired attack.
10. Competence in recording and interpretation of data.

Dr. Todd then posed the questions—Are these qualities essential? Are they distinguishable, measurable, related to competence and critical? He feels that there is considerable evidence to prove that they are critical, especially in combination when selecting a good technical or research man.

He felt that George Bennett's idea that superior research personnel can only be selected by a combination of the following was worthy of commendation: a complete analysis should consist of an evaluation of the candidate's achievements at school and at work, an appropriately planned and conducted interview, and finally if possible he should be given a properly selected battery of tests.

The evaluation of school work and experience call for consideration of a transcript of the candidate's grades, records of honors and school activities, his ratings in any performance reports the school has available, the letters of recommendations from his teachers or former employers, and a close study of the way he has answered the questions on the application for employment. Employment forms are now available through certain organizations that put the questions to the applicant in such a manner that much information can be obtained about his character and personality by the way he frames his answers. Dr. Worthington, a clinical psychologist, has designed a data sheet which the applicant fills in without realizing it is an application sheet. The psychologist then analyzes the answers and gives the employer his analysis of the character of the applicant.

Dr. Worthington points out there is no substitute for the personal interview of the candidate alone and also in a group situation. The group members may include board members who make the final decision on employment of new personnel and possibly a psychologist. In groups certain situations may be created to obtain the candidate's reactions.

As an additional check on the qualifications of the candidate a battery of selected tests may be used and the candidate's rating can be compared with the ratings of personnel already employed in the type of work he is being hired for to see if his ratings follow the group pattern.

Dr. Todd demonstrated the results of some of the groups tested by showing slides. He further classified the tests into such other groupings as knowledge tests, intelligence tests,

productive thinking tests, character tests, questionnaires, and projective tests.

The tests of knowledge are often standard tests given in chemistry, physics, and other subjects in the college and the candidate may know his score or the college may furnish it on request to a prospective employer. Intelligence tests include college aptitude and selective service tests. Psychological Corp. has a productive thinking test, the results of which can be compared with known levels of performance for a known group. There are now available some 500 different tests which are used to determine the character of the applicant.

The questionnaire answers are usually compared with known behavior of persons previously tested.

Projective tests are usually conducted with ink blots or pictures. The candidate is shown the various blots or pictures and asked what they suggest to him. An experienced tester can get a great deal from such personal reactions.

Personality tests are used mostly for personnel required to do confidential or spy work. They are told to assume a certain character or conceal certain information from their group. Other members of the group also are charged with the same responsibility. They then try to find the other person's secret or real identity. They are even served drinks to see if they will break "cover" under the influence of alcohol.

Because of the wide choice of jobs for each available graduate the colleges are now developing placement advisers to help these men pick the jobs for which they have the best qualifications if the graduates ask their help.

There is a 13 to 40% increase in freshmen enrolled in engineering and technical courses this year over last year among the various colleges offering this type of training.

Summarizing his talk, Dr. Todd brought out that many factors have developed the need for technical personnel with certain essential qualifications. Tools and methods of making the proper selection for the specific jobs in the paper industry are within the reach of all employers and are now being widely used. Untrained persons should go slow, however, on interviews and tests and should not hesitate to get professional help from colleges and universities or trained consultants in the employment field in selecting personnel for technical jobs.

In the discussion which developed after this excellent presentation by Dr. Todd several very interesting ideas were explored. It was felt that the paper industry should attempt to develop an attractive brochure to justly represent the third largest industry in the nation. The oil companies and electrical manufacturers and the chemical and steel industries have developed such brochures and implemented them on the college campuses by sending men highly placed in their organizations to follow up on these brochures and make their industries as attractive as possible to the graduates. A student adviser recently approached on the campus of one of our state universities said "What is this paper industry? I've never heard of it before."

There does seem to be a field for some constructive publicity for the paper industry if we are to get our share of technical personnel from the colleges in competition with other industries.

A suggestion was also made that an aptitude test be prepared to check a candidate's interests which might lead him to an interesting career in the paper industry. A liking for mathematics and a sensory test indicating a highly developed sense of smell were humorously suggested as possible aptitudes indicating an interest in our industry.

Don Jenkins, program committeeman in charge of this meeting, and Chairman Ed Brandon expressed the appreciation of Ohio TAPPI to Dr. Todd for his fine presentation of a timely and vital subject and the warm and friendly manner in which it was presented.

GEORGE B. GREGG, *Recording Secretary*

Lake Erie

The Lake Erie Section met at the Hotel Carter in Cleveland Ohio, on February 20. Fifty members attended. A. T. Luey of the Sutherland Paper Co., Kalamazoo, Mich., was the principal speaker and talked on "Surface and Body Characteristics of Board for Printing."

Mr. Luey's talk follows:

Surface and Body Characteristics of Board for Printing

A. T. Luey

THE subject has been divided into two parts—body and surface characteristics that affect printing—and will be discussed in that order.

BODY CHARACTERISTICS

Uniformity of Caliper

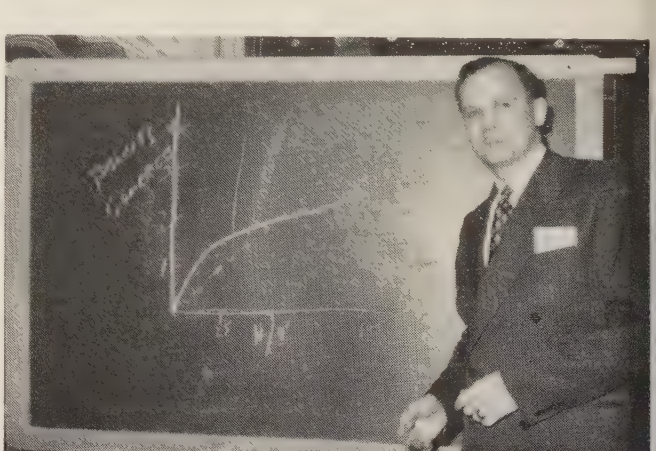
Because of the necessity of a squeeze or impression in printing boxboard, uniformity of caliper is very important. In making ready for a job the pressman will adjust his packing to produce an over impression of about 0.001 in. on halftones up to 0.008 in. on solid areas. Obviously a caliper variation of the board will upset the pressman's calculations so he will not obtain the desired result in printing.

There are several types of caliper variation which may occur. First there is the "spot" variation due to poor formation at the cylinders. This results in shallow or thick areas about 1 in. in diameter. Second, we have variations across the sheet (cross machine direction) due to streaks, heavy or light edges, improperly crowned press rolls, or calender stacks. Third, we have variations in the machine direction with time, usually due to changes in stock consistency coming to the machine.

All of these variations will cause similar problems at the press. When the caliper is too light the printing breaks up. Obviously the result is more pronounced in the halftone areas where the impression is the lightest. This break-up is due to two factors which are closely related. First, a decrease of impression will result in a decrease of smoothness of the board at the time of printing. Second, the ink transferred from the plate to the board will decrease if the impression is sufficiently decreased due to lack of 100% contact between board and plate. Since the smoothness has decreased, more ink is required, and since less ink is being transferred than planned, a break-up in printing results.

Trade tolerances specify a maximum caliper variation of ± 0.001 in. or 5%, whichever is greater. For high quality

A. T. LUEY, Engineer, Technical Dept., Sutherland Paper Co., Kalamazoo, Mich.



A. T. Luey, Sutherland Paper Co., addressing the Lake Erie Section meeting

printing, such as 120-line screen multicolor process work, this variation should be cut in half. However, there are very few mills that can keep 96% of their production within the trade tolerances.

Streaks and heavy and light edges will cause another problem at the automatic feeders. This type of caliper variation will cause uneven loads. The stock pilers can help this problem by rotating alternate lifts 180° or by using boards to even up the load. Heavy edges will sometimes give the appearance of curl.

Curl

Curl in boxboard can be caused by a large number of factors, all of which contribute to make a difference between the top and back liners. One of the easiest to visualize is the wet calender stock where water and chemicals are applied to the board surfaces. If, for example, you are adding a starch treatment for gloss ink printing, it is possible to make the board curl into tubes or "stove pipes" in paper mill language unless the proper balance is maintained in water treatment on both sides of the sheet.

At the press curl will cause operating problems at the feeders, and some of the new high-speed presses cannot tolerate what would normally be considered a negligible amount of curl.

At our plant we measure the curl of board by taking a 4-in. square sample, letting it age at normal room conditions for 30 min., and then measure its radius of curvature by holding it against a marked plate. The use of a small sample is desirable since a large sheet will frequently stay flat due to its own weight.

Additional comments of this problem are made later under moisture content.

Moisture Content and Relative Humidity

Boxboard will normally average 6% moisture and the usual tolerance is ±1%. Variations in moisture are usually due to changes in the weight of the sheet which results in a variation in the load on the driers. Minor variations will usually even themselves out in the load within 24 hr.

Abnormally low moisture content (3 to 4%) will frequently cause bending and folding problems while an excessively high moisture (8° plus) will cause ink drying problems in the pressroom. Both are likely to cause dimensional changes in the sheet as the board comes to equilibrium with the surrounding humidity. Also, a board with normal moisture content will change in size if put into low or high humidity. As a result some mills will run the moisture content on the low side during Winter and on the high side in the Summer to minimize these dimensional changes.

In 1940 I made some measurements in a controlled humidity cabinet which showed that for every 15° change in relative humidity at 72°F. a 3-ft. piece of clay-coated board would change 0.02 in. in the machine direction and 0.07 in. in the cross machine direction. Accurate measurements in the field are impractical because of the difficulty in getting the exact moisture content of the board. But in one case of a four-color job being run on two two-color presses, the register marks were 1/4 in. out on the trailing edge of the sheet.

Due to the tendency of boxboard to come to a moisture content in equilibrium with its surrounding humidity and undergo dimensional changes in the process, we encounter several other problems. A load that picks up moisture can develop ripples on the edges as well as cockle in the top sheets. One that dries out will shrink on the edges and produce a dished effect. This can produce register trouble on a two-color press as the blister or extra board in the center can go one way on the first cylinder and a different way on the second cylinder.

Any change in moisture content can produce a curl due to the difference in coefficient of expansion or contraction of the top and bottom liners with changes in moisture content. An extreme example of this is boxboard laminated to glassine or greaseproof paper. The glassine will contract to a much greater extent than boxboard on drying and will produce an extreme down curl under these conditions.

Some printing houses have recognized the importance of these problems and have installed humidity control equipment and at the same time hold their board suppliers to rigid moisture content specifications.

Rupture Strength and Pick

The use of tacky gloss inks, or high tack inks, in a multicolor process job for good trapping requires a board with good rupture strength or blistering will develop during the printing. Inks can be modified to overcome this problem but at a sacrifice of quality.

Unfortunately, instruments are rarely used to measure the board or ink on these occasions and the whole affair degenerates into an unsatisfactory argument. Some concerns find an Inkometer very useful to determine the tack rating of their inks. The fact that this test is carried out at a very carefully controlled temperature illustrates the importance of press temperature in relation to this problem.

The rupture strength of board can be measured by means of the liner pull test (*1*), tack rated inks in conjunction with a proof press and by pick testers currently being developed by Hercules Powder Co. (*2*). Although the Dennison wax test is commonly used, its correlation to printing problems is open to various operations and has been discarded by many.

Improper bonding of the liners is a common cause of blistering. An extreme example of this is a "blow" in which the layers of the board will not be bonded at all.

A very weak top liner or underliner, due to a improper furnish, can produce a similar defect.

Picking, due to loose fibers or foreign material in or on the top liner can be due to a variety of causes. Large undefibered fiber bundles in the top liner, picking of a press felt, slime spots that stick to the calender stack and then break off in hundreds of little pieces are typical examples.

On clay-coated board insufficient adhesive will cause picking of the coating. At times it is difficult to distinguish between this and blistering. Picking on the trailing edge of a plate is a common occurrence on coated board and usually results in interesting discussions. One successful carton plant superintendent admits it is due to improper makeready. Others have disagreed wholeheartedly. I have never seen conclusive proof for either argument.

Compressibility

This is closely related to smoothness and will be discussed under that heading.

SURFACE CHARACTERISTICS

Color and Brightness Uniformity

Variations in the color and brightness of board make it very difficult for the printer to control his color, especially if he is using transparent inks. Although there are methods for accurately measuring color and brightness, such as the M.I.T. spectrophotometer, such instruments are extremely expensive and difficult to use. Normally, a critical customer will furnish samples showing the desired standard and acceptable tolerances both in shade and brightness. Unfortunately this information is usually lacking and as a result it is the responsibility of the board mill to produce a color match that is "commercially satisfactory." This is exactly the same thing that is done in printing houses in matching colors of proofs.

There is obviously a need of acceptable instrumentation in this field and the development of accurately defined trade tolerances.

A wide variation in brightness exists in the BMLN grades and the WPCN grades due to a variety of factors. Increasing competition and a greater availability of raw materials have

resulted in substantial upgrading in the past few years. Attempts to match samples presented by critical purchasing agents account for many different grades.

The desired tolerances of brightness are narrowed as the quality of the board is increased. And fortunately it is possible for the board manufacturer to meet this situation as he will use higher quality raw materials in the expensive grades of board. Thus it is quite common for an average BMLN with a brightness of 55 to have a variation of ±2 points. A patent-coated news with a brightness of 70 will have a variation of ±1½ points. And a clay-coated board with a brightness of 80 will have a variation of ±1.

Sizing for Gloss Inks

Of the many variables that will affect the gloss result in gloss ink printing, one of the most important is the surface treatment of the board. Top liner formation also is an important factor. Regardless of how the results are reached we have the problem of accurately measuring this characteristic. Of the various methods for testing the gloss ink printability of boxboard, the Vanceometer appears to be the most satisfactory. A reading of 80 to 90 after 1 min. has been adopted as a standard by some board producers. Care should be taken that the test is made at a temperature of 72°F.

Although objections have been made to the accuracy of this instrument, to my knowledge no better test method has been developed.

Smoothness

Undoubtedly the most important surface characteristic of boxboard that affects printing is its smoothness. Here, there are two important types of variation: (a) the frequency of variation from the normal plane and (b) the amplitude of the variations (*3*). Because of this it is possible to get similar smoothness tests using a Bekk instrument on grades of board that will have entirely different surfaces and printing characteristics. (All future references to smoothness refer to the Bekk instrument.)

An example of this would be in the comparison of a WPCN made on a cylinder machine and a kraft fourdrinier board. Both may have a smoothness test of 25 sec., but the ink consumption (which in itself is a good measure of smoothness) of the fourdrinier board might be 25% higher than the cylinder board.

The smoothness of the board at the time of printing, i.e., when the board is compressed between the plate and the cylinder, is of primary importance. Much investigation has been done correlating smoothness with pressure. This can be misleading as the pressure itself is not the factor involved in changing the smoothness of board, rather it is the amount of compression that takes place.

A mathematical analysis of the data available in J. F. Halladay's "Printing Use Requirements of Boxboard" (*Paper Trade J.* 151, No. 23: 35–44 (June 23, 1938)) shows that the smoothness of boxboard is proportional to the seventh power of its density. (Density is pounds per 100 sq. ft. per point of caliper.) This relation will hold for the smoothness and densities of different sheets of board and for the same sheet of board at various degrees of compression.

This relation may be expressed as a formula

$$S = \frac{D7}{A}$$

in which A is a constant that varies with each sheet of board.

The printer shows that he is aware of this general relation when he applies extra squeeze or impression in order to print a rough sheet of board. Also he knows that the more compact his backing paper is the better will be the printing result.

The amount of squeeze or compression that takes place in itself determines the pressure at the time of printing. And this compression does take place or the cylinder of the press is lifted off the bearers, a situation which cannot occur in good printing.

The formula expressed above holds for different sheets of board, relating the original density to the Bekk smoothness determined at 10 p.s.i. and can be written

$$So = \frac{Do}{A}$$

The formula also holds for the smoothness of a single sheet at various degrees of compression and may be written as

$$Se = \frac{De}{A}$$

By combining these two formulas we get

$$Se = So \left(\frac{De}{Do}\right)^7$$

And this formula may be rewritten in terms of caliper as:

$$Se = So \left(\frac{C}{C - E}\right)^7$$

in which Se is the smoothness at compression E, C is the points of original caliper, and E is the points of compression or deflection.

Using this formula the calculated smoothness of 21 samples at 0.003 compression averaged 47.6 sec. while the smoothness according to actual test averaged 48.8 sec. The average difference between calculated and test results was 4.7 sec.

If we apply this formula to an actual case of printing 0.016 board with a compression of 0.003 in. then on the average the board will be compressed 0.001 in. and the backing paper 0.002 in. so we get

$$Se = So \left(\frac{16}{16 - 1}\right)^7 = 1.6\ So$$

For higher calipers the compressibility of the board increases, and since less packing is used its effect decreases, and for the *average* of the samples studied the above relation will hold for all calipers.

The selection of 0.003 in. as an average compression can be a misleading factor. In halftone printing where smoothness is of great importance, standard make-ready procedures call for a build-up of the solids. On four or five-color presses the plates will be treated so that the solids will be 0.004 to 0.006 in. higher than the halftones. Under these conditions the squeeze on the board vary accordingly from a "kiss" impression on the finest of halftones to a squeeze of 0.006 in. on the solids.

Further complications arise in calculating the compression of board during printing when backing sheets of a synthetic rubber-cloth combination are used. This has been described as an aid to quick make-ready and an aid to printing when there are caliper variations in the board. However, if the printer wishes to add squeeze to compensate for roughness, this would appear to be a step in the wrong direction.

Regardless of these factors, the compressibility of board is a determining factor of its smoothness during printing. And since the thickness and type of backing paper play an important part in this, it would appear in order to make the smoothness test under a standard compression of a combination of board and packing.

Since the pressure developed during printing is equal and opposite to the resistance of the board and packing to compression, it is possible to calculate this pressure graphically from pressure-compression curves. This was done using the data for the grades of board normally used in printing and it was found that the pressure varied from a low of 25 p.s.i. for 0.0315 BMLC to a high of 85 lb. on a 0.022 WPCN. This particular WPCN was unusually hard to compress. At a compression of 0.06 in. the pressures will run from 100 to 200 lb.

It is of course important to note that these are static pressures and that in printing we have a dynamic system. However, regardless of the nature of the pressure, static or dynamic, the compression is the important factor in affecting the smoothness. And it would appear reasonable to assume that the smoothness developed by compression will be the same whether it is due to static or dynamic pressure.

LITERATURE CITED

1. TAPPI Routine Control Test RC-6.
2. *Tappi* 34, No. 10: 433–488 (Oct., 1951).
3. Instrumentation Studies, VIII (2), *Paper Trade J.* 104, No. 11: 43 (March 18, 1937).

Q. How far do you deviate on a commercial color match?

A. A series of samples are made up showing all ranges of color and the limits of acceptability are defined within this range. A coating is made to standard formula and then doctored to match by eye under various lights. It is very difficult to get an exact match. Brightness of pulp shipments, clays, titanium dioxide, and pigments are some of the variables which affect a color match.

Q. Why can't you get a hard surface with a black that you can get with a yellow?

A. The difference in pigments, especially in black, will vary the hardness of the surface. Black is a very absorbent pigment. Perhaps adding more adhesive would help.

Q. Does the speed of the presses affect printability more than the stock itself?

A. Thixotropy of ink would permit a change in its flow caused by the speed of the presses. However, this depends on the type of ink used, so generally speaking the press speed would not have as great an effect.

Lake States

The fourth Lake States Section meeting of the current season was held at Green Bay, Wis., in the Northland Hotel at 6:30 p.m., March 10, 1953 with about 170 persons attending.

Chairman H. W. Rowe announced that the next meeting would be held April 15 with an afternoon tour of the Nekoosa mill of the Nekoosa-Edwards Paper Co. followed by a panel discussion, "Wet End Operating Conditions and Paper Qualities." B. L. Kassing, Nepco Director of Process and Product Development, will serve as moderator. Dinner will be served at Wisconsin Rapids in the Elks Club, followed by an after-dinner address.

The data of the annual social meeting has been changed from May 12 to May 19, 1953, and will be held at the Butte des Mortes Country Club, Appleton, Wis., with golf in the afternoon, dinner at 6:30 p.m., and appropriate after-dinner program.

Tribute was paid to the late C. J. West for his outstanding work in the field of cataloguing the literature of the pulp and paper industry. Dr. West was a highly respected member of the Lake States Section.

Introducing the Panel Discussion of Savealls, Moderator Clyde Faulkender of Hoberg Paper Co., Green Bay, emphasized the increasing importance of savealls in paper mills as a means of reclaiming valuable materials and heat as well as reducing stream pollution to meet government requirements. He briefly enumerated the various types of savealls in use, and proceeded to call on the first speaker, F. O. Sullivan of Infilco, Inc., to discuss the sedimentation type saveall.

Using a slide projector, Mr. Sullivan showed a sketch of the Infilco "Cyclator" and briefly explained its design and principles of operation.

Mr. Richard Ahrens of The Improved Machinery Co. outlined the history of the mechanical filter-type of saveall for white water, and described the various modifications which have been used. The Pre-Coat Waco filter was then described in some detail and its operation was discussed. The factors to be considered in selecting a saveall were outlined and discussed.

Paul Easton of Sveen-Pedersen Sales Corp., gave an historical account of the development of the flotation type saveall and gave a detailed description of the mechanism and operating principles involved in the Sveen-Pedersen Saveall.

In the question-and-answer session following the formal presentation of the papers, it was brought out that heavy concentrations of stock in the white water can readily be handled by the mechanical type saveall and the reclaimed stock comes out at relatively high consistencies which may require dilution before pumping.

In contrast the sedimentation and flotation types cannot handle excessive amounts of stock in the white water, and where such concentrations may occur the white water must be given a preliminary mechanical screening. The reclaimed stock from these two types is at relatively low consistency and can be readily pumped.

Mr. Easton did not feel that reuse of stock from the flotation type saveall would cause any increased tendency for foaming at the machine.

The sedimentation type saveall requires considerably more time for a wash-up and color or grade change than the other two types.

Mr. Sullivan mentioned a new Infilco development, the "Sedi-Floter," which is designed to separate floating and settling solids at the same time in the same equipment.

L. A. Moss, *Secretary*

Empire State

Northern District

W. F. Luckenbach, Jr., Manager, Industrial Sales Dept., Virginia Smelting Co., West Norfolk, Va., spoke to members and guests of the Northern District, Empire State Section, Woodruff Hotel, Watertown, N. Y., on March 12, 1953 on the vitally important subject "Sell for America."

Mr. Luckenbach presented his views in the manner of the old song, "Accent on the Positive and Eliminate the Negative" in our everyday selling of the American way of life. We, as technicians, performed the most prodigious job of selling that anyone has ever known when we sold, sight unseen, the atomic bomb project. Why should not that same selling potential be directed to selling America? We can do it, Mr. Luckenbach said. The "isms" which others put up to us as being good as or better than our Americanism are likened to a rotten egg thinks Mr. Luckenbach, i.e., they have a sleek, shiny, eye-appealing surface but once that fragile surface is cracked the true rotten nature is evidenced by the smell.

Mr. Luckenbach asked a very interesting question. Do you know what your children are learning in school every day? Who are the authors of their school books? You might be shocked should you take the time to investigate. There are some school books which given a definite anti-American slant to the student. This job of reselling America is not one for the professional salesman. It is a job to be done by each and every one of us every day. It must begin at the "grass roots" level—in our towns and villages.

Richard J. Murtaugh, *Secretary*

Empire State (Eastern District)

Eastern District

The Eastern District of the Empire State Section met at La Cabana Restaurant, Glen Lake, N. Y., on Feb. 12, 1953. Robert March of the Marinette Paper Co., Fort Edward, N. Y. presided as chairman. Sixty-five individuals were present. The program was debated to the consideration of Routine Control Methods.

The presentations follow:

Bleachability Test for Highly Lignified Pulps

Horton Girdler

Up to the present time no satisfactory bleachability control test for highly lignified pulps has been published. Lignin determinations and chlorine consumption measurements are too complex and time consuming to be of value as control tests. The usual 25 or 40 ml. TAPPI permanganate numbers tests are unsatisfactory for these pulps because the permanganate is nearly exhausted by the pulp. The range of permanganate numbers resulting from a series of pulps of widely varying chlorine demand is quite narrow. The permanganate number for a given pulp sample is also influenced by the degree of subdivision of the pulp. Fiber bundles, due to the smaller reactive surface per unit weight, tend to react to a lesser degree with the permanganate than do individual fibers. For this reason it was found necessary to reduce the pulp samples to a uniform degree of subdivision before reacting them with permanganate.

After much experimentation, the following procedure was developed:

1. Take approximately 10 oven-dry grams of wet pulp and place in the pan of a Moisture Teller. Dry for 10 min. at 200 to 210°F. Remove the pan, crumble the partially dried pulp, and dry for another 5 min.

2. Grind this dry pulp in a Wiley mill to pass a 60-mesh screen.

3. Take approximately 2 oven-dry grams of the ground pulp and place in the Moisture Teller for 5 min.

4. Weigh 1.010 grams of this dry ground pulp on a watch glass as rapidly as possible.

5. In a large beaker, or, as we used, a 5-lb. reagent bottle, place 2500 ml. of distilled water and 200 ml. of 4 *N* H_2SO_4. The temperature should be adjusted to 25 ±1°C.

6. Add the weighed pulp sample to this solution and stir throughout the remainder of the test with a mechanical agitator fitted with a glass impeller.

7. Add 200.0 ml. of 0.1 *N* potassium permanganate from a beaker, washing the beaker clean with 300 ml. of distilled water which is also added to the large beaker.

8. When exactly 10 min. have elapsed from the time the permanganate was added, stop the reaction with 40 ml. of 1 *N* potassium iodide.

9. Titrate the liberated iodine with 0.1 *N* sodium thiosulphate, using a starch indicator for the end point.

10. The NSSC number is found by subtracting the milliliters of sodium thiosulphate from 200.

To differentiate this test from the TAPPI permanganate test, the number of milliliters of permanganate consumed is called the NSSC number. The test is simple, fairly rapid, and gives reproducible results. Excellent correlation has been found to exist between the NSSC number and the per cent chlorine required in the first stage of a three-stage bleaching sequence to reduce the TAPPI permanganate number after alkali extraction to 4. A very desirable spread of NSSC numbers was found to result from variations in chlorine demand of neutral sulphite semichemical pulps; there being approximately 4 NSSC numbers for each 1% chlorine required.

Wet-Strength Test for Hanging Stock

Paul L. Page

Hanging stock, which is used for making wallpaper, requires a certain degree of wet strength for the paperhanger's convenience. This is not a true or saturated wet strength but more of a semiwet strength as the paper should never reach complete saturation before it has been satisfactorily positioned on the wall.

After the paperhanger pastes the strips of wallpaper he usually allows them to soak from 5 to 10 min. before hanging. This soaking is necessary to give the paper sufficient time to expand. Most paperhangers also feel that the flexibility and softness obtained by sufficient soaking aid them in obtaining a more neat and perfect job. As can be seen an 8 or 10-ft. strip should have sufficient strength after the soak so that the paperhanger can handle the strip without damaging it.

We have found that the paperhanger has little trouble with tear or tensile but that his biggest difficulty is in keeping his thumbs or fingers from going through it.

A couple of years ago we were receiving quite a few complaints of this nature and decided something should be done to improve the strength of the sheet when in this semisoaked condition. The paperhangers were complaining that the sheet was too soft, soaked up too much paste, and fell apart while they were hanging it. Of course, like any complaints, these faults were greatly exaggerated but we found it was true that some of our paper did have poor strength after it had become partially soaked. At first, we thought the main trouble was caused by poor sizing and so attempted to analyze this problem through sizing tests, such as the ink and Cobb. It was soon learned that sizing, as measured by standard sizing tests, was not the right answer.

After working with the sizing tests, we switched to various wet-strength tests. The wet tensile didn't measure the properties we wanted to know as a paperhanger seldom has trouble with tensile strength. His troubles are usually caused by ruptures more like a burst, but the wet bursting strength of a hanging stock is too low to reliably measure on a Mullen tester. After working with the bursting strength for some time it was decided to develop a test which would closely simulate the paperhanger's conditions. It is believed that the test we now use does correlate quite closely with end use. We call it a wet-strength tester but in reality it is more of a semiwet strength tester and correlates more closely with sizing than it does with true wet strength. This test measures the soaking time required to allow a certain force to rupture the sheet. By varying the force two important variables can be found: (1) the wet strength at different soaking times and (2) the rate of losing strength with soaking. The test specimen is soaked from only one side, the same as the paperhanger soaks his sheets. We are most interested in the strength between 5 to 10 min. soak because, as mentioned previously, this is the average elapsed time between when the wallpaper is first pasted until it has been completely secured on the wall. To fix the position of the curve it was found that the test force should be varied so as to obtain points between 2 and 15 min.

The tester was made from a standard 2-kg. torsion balance, a Cobb size tester, a 1-in. diameter marble, and a set of weights. The pans and slides were removed from the balance. The marble was then mounted on one side and a small light weight pan on the other. A 4 1/4-in. hole was cut in the bottom of the Cobb tester and the whole tester mounted on legs so that it could be placed over the marble. This makes the complete tester except for a few slight modifications to make it easier for the operator. To make a test the sample is placed in the modified Cobb in the usual manner. As 80 ml. of water are poured in the Cobb apparatus, the time is started. After 30 sec. the preselected weight is placed on the pan bringing the marble firmly to bear against the bottom or dry side of the test sample with a force equal to the weight on the pan. When the sample ruptures, the time is noted. The 30-sec. delay before the weights are added was selected mostly for standardization but partially because we believed the soaking should start before any pressure is applied to the specimen. To make it easier for the operator, the tester was

Horton Girdler, General Foreman, NSSC Pulp Mill, West Virginia Pulp & Paper Co., Mechanicville, N. Y.
Paul L. Page, Imperial Paper & Color Corp., Glens Falls, N. Y.

wired so that a buzzer sounds when the test is completed. One tester is also wired with a stop clock so that the clock is stopped when the paper ruptures. These little aids speeded up testing by allowing the operator to prepare the specimens and run other tests while the long time tests are being made.

After the test series have been completed, the data are plotted as force to rupture versus time of soak. This gives a fairly good story of the strength in the 5 to 10-min. soak zone and also shows the rate with which the paper is losing strength while soaking. In the small area which is observed (2 to 15-min. soak), the curve approaches a straight line on a log-log plot. Of course it is known that the entire curve is not a straight line because it has definite limits, but, because of the close approximation obtained in the limited range we work in, we have found the log-log plot much easier to record and study. This method of testing has no upper limit except time of soak. Very short soaking periods are not advisable because if the time is less than $1^1/_2$ min. the wet strength begins to approach the dry strength and the log-log straight line relationship is no longer valid. A limit also is found in the low strength range when poor sizing is encountered. In this case, the wet strength begins to approach the completely saturated wet strength, but with most hanging stock the saturated wet strength is less than can be accurately measured with the instrument. The lower limit of the instrument appears to be about 100 grams force. A smaller load does not put sufficient force against the paper to give consistent results as other variables such as elasticity, expansion, head, etc., become large in comparison to the small force exerted on the paper.

As would we imagine, this type of wet strength is quite sensitive to temperature. Any increase in water temperature increases the rate of penetration and this reduces the wet strength. Moisture content of the paper also alters the results but the effect is much less. To obtain consistent results we have found it advisable to do all our testing at standard conditions. The specimens are conditioned and the testing accomplished at 50% relative humidity and 72°F.

The wet strength also changes with sample age. Fresh paper, tested a few hours after it comes off the machine, has a much lower wet strength than paper a week old and after a year the paper has a better wet strength than it did after 1 mo. The rate of pickup decreases with increasing time, the greatest pickup occurring during the first few days. Sometimes, during experimental plant runs, the paper is tested soon after it comes from the machine but most of our testing is done after 3 or 4 days. We have made only a brief study of the effect of aging on wet strength, so no figures can be given on the mathematical relationships, just the trends. We were unable to speed up aging and obtain good correlation with the naturally aged samples but very little work was done on this phase.

There is no set or hard fast correlation between this wet-strength test and the Cobbs and ink test but, in general, there is some correlation. A paper with very poor apparent sizing has poor Cobb, ink, and wet strength; but, a paper with good ink and Cobb test need not necessarily have good wet strength.

This type of wet-strength test is of little value in testing an unsized sheet because the results are so closely related to and dependent upon the effective sizing. In fact, the tester could probably be used as a size tester if the other variables were held constant.

Wet-strength resins flatten the curve of force to rupture versus time of soak, while increased effective sizing tends to push the whole curve up. An increase in the 10-min. break could be accomplished by two different methods, either through wet-strength resins or better sizing. When we first decided to increase the 10-min. break we did it with wet-strength resins. This flattened the curve so that the desired 10-min. break was obtained with only a slight increase in the 2-min. break. We later abandoned this method and obtained the desired 10-min. break through sizing. By improving the sizing efficiency the entire curve was pushed up. The curve was slightly flatter with the increased sizing but the principal effect was an over-all increase in wet strength. The end results were no more desirable than those obtained with wet-strength resins but the cost was less as we used very little more rosin through increased sizing efficiency.

This tester has a couple of disadvantages which should also be noted. One is that a complete test is quite time consuming and the other is that an incomplete test is unreliable. A complete test is varying the force so that the rupture times are scattered between 2 and 15 min. Single observations, like taking the average of three readings using the same force, are apt to be quite inaccurate. This is one of the principal reasons why we plot all our data on the log-log plot. The log plot gives a more accurate picture and tends to smooth out the data. The override, testing between 2 and 15 min., when we are only interested in the results between 5 and 10 min., also gives the data in the desired zone a much higher degree of accuracy.

The wet-strength tester has been used as a control instrument for over 18 months. We have found it very useful in producing a better hanging stock as it correlates quite closely with customer complaints which is the true value of any test. As mentioned previously, we still use the Cobb and ink test to measure sizing but the wet-strength test is used as the real test of quality.

Outline for a Felt Control Program

James Tipka

Purpose

To improve felt life and performance.

Magnitude

Large in magnitude but work can be minimized as program develops.

Personnel Involved

Production and technical control departments, felt manufacturer.

Considered Three Factors in Originating Program

1. By working closely on felt specifications and design with felt manufacturer.
2. Technical control department appointed coordinator to collect, record, and analyze necessary information and make recommendations.
3. Production department appointed to correlate machine operation information for technical control department as records and to take definite action to correct poor machine conditions.

Forms Prepared and Testing

Two forms were prepared by technical control department with aid of production department. Data collected and testing of felts done by control department.

Results

Gains realized in life and performance due to cooperation and interests by departments involved and felt maker through changes in design, close analysis of the data collected, and changes in machine operation.

Suggestions for an Effective Felt Program

1. Cooperation and efforts of departments involved.
2. Acknowledging your felt problems when at fault.
3. Be willing to experiment with new style felts.

James Tipka, Process Engineer, Marinette Paper Co., Fort Edward, N. Y.

4. Consider felts, not by days ran particularly, but how much water was removed, steam saved, speed and production realized.

5. Remedy as many defects in operation as possible.

6. Maintain a close working relation with your felt supplier.

B. & L. Gloss as a Routine Control Test

Oscar Anderson, Jr.

"Gloss," "glare," and "finish" are terms which have various meanings to various people. In this discussion, I will refer to "gloss," as meaning the properties of paper measured by the B. & L. Glossmeter; to "glare" as meaning the properties of paper measured by the Ingersoll Glarimeter; and to "finish" as meaning the visual appearance of the surface of a sheet of paper.

At the Hudson River mill, we use the B. &. L. Glossmeter for routine control testing on most of our supercalendered paper, but we do not use it on any machine-finish paper because our machine-finish paper would give readings too low on our glossmeter as we have it calibrated.

Our B. &. L. Glossmeter essentially fulfills the requirements listed in TAPPI Tentative Standard T 480 for apparatus to measure the specular gloss of paper at 75°. The apparatus is arranged so that a light source throws a beam of light through a positive lens onto the sheet of paper to be tested at an angle of 75° with the perpendicular, or 15° with the sheet itself. A light receptor containing a photocell is located opposite the light source with an opening so arranged that the light reflected at 75° is received by the photocell. The amount of light which the photocell receives is determined by the gloss of the paper sample and a reading proportional to the amount of light is indicated on a galvanometer graduated from 0 to 100 units of gloss. The light source, light receptor, etc., are enclosed in a box having a 4 by $^3/_4$-in. opening at the top over which the paper sample is placed.

Our procedure for using the B. & L. Glossmeter is as follows: we obtain a strip of paper about 6 to 8 in. wide across a roll of supercalendered paper. Before taking gloss readings on this sample, the tester adjusts the reading of the Glossmeter with coarse or fine potentiometer knobs to a reading near 100, the exact reading being determined by daily calibration. Then gloss readings are taken every 4 to 8 in. the length of the sample and on each side of the sample. These readings can be averaged mentally by the tester since normal variation across a roll is only about 5 units. Rechecks on separate samples from the same roll generally give averages which agree within 2 units. The testing method is rapid, easy, gives reproducible results, and is not subject to variation due to different testers' eyes.

Calibration of the instrument is made daily by adjusting to standard gloss readings on white ceramic squares furnished by the Henry A. Gardner Laboratories. Then the reading of the meter with no sample is observed and posted.

The actual meaning of the gloss reading on a given sheet is a point which is open to much debate. Attempts have been made to correlate B. & L. gloss with Ingersoll glare, and attempts have also been made to correlate each of these with visual finish. Complete correlation was not obtained in any of these studies, and the reason for incomplete correlation can, I think, be explained by the nature of the surface of supercalendered paper plus the differences in construction of the gloss meter and glarimeter.

The surface of supercalendered paper can be described as "smooth" and "shiny." *How* smooth and *how* shiny are of importance to the printer—"how smooth" will mean how *evenly* his ink will lie on the sheet; "how shiny" will mean to what degree his ink will *stand out* on top of the sheet.

If supercalendered paper is examined under a microscope, it can be seen that the sheet is a mass of "hills and valleys." Smoothness is a measure of the variation between these hills and valleys—if the smoothness is high, the hills are mere hillocks; if the smoothness is low, the hills are mountains. If the sheet is shiny, the hills are more like plateaus; if the sheet is dull, the hills are jagged peaks. Supercalendering makes the sheet more shiny by crushing the peaks to make plateaus out of them, but if these plateaus are still high plateaus after supering, the sheet will be shiny but not smooth.

B. & L. gloss, to a certain extent, tells how shiny and how smooth a sheet of paper is. The amount of light which is reflected by the paper toward the photocell depends partly on both qualities of the paper, because, even at the high angle of incidence (75°), low smoothness will cause some light to be reflected diffusively. The less the smoothness, the greater this diffusively reflected light, only a part of which will pass through the opening in the receptor, and consequently, the lower the gloss reading.

When visually inspecting the finish of paper, every person has his own preference as to type of light source, angle of incidence of light, and angle of viewing. Most people will stick to one certain light source, but will vary the position of the sheet until they can "see" the finish best. It may well be that in visually inspecting various samples which have been tested for B. & L. gloss, the person inspecting will use a different angle of incidence than does the glossmeter. (The Ingersoll glarimeter employs a 57.5° angle of incidence.) Varying the angle of incidence changes the picture of the finish; thus, the gloss meter and glarimeter do not measure exactly the same thing. This variation in angle of incidence probably accounts for most of what lack of correlation there is between B. &. L. gloss, Ingersoll glare, and visual finish.

In the final analysis, the visual finish of the sheet of supercalendered paper is probably the best indication of "how smooth" and "how shiny" the sheet is. A visual inspection of finish, then, is the next best test to actually printing the sheet to determine how it will print. However, visual grading of finish requires a trained eye and one particular light, both of which vary with various testers. Any instrument with which we attempt to measure finish naturally must make these variables constants, which the B. & L. Glossmeter does with a constant voltage to the light source and a constant angle of incidence of the light. We have found that the B. & L. Glossmeter gives us a better indication of finish than any other test, even though the test does not always confirm the finish we see with our eyes. The B. & L. gloss test serves the purpose of a routine control test—it gives us a good indication of the finish, and it gives us figures for comparison and future reference.

Oscar Anderson, Jr., Technical Supervisor, International Paper Co., Palmer, N. Y.

Empire State

Western District

The Western District of the Empire State Section met at the Prospect House, Niagara Falls, N. Y., on Feb. 4, 1953. Gordon K. Storin of the Niagara Alkali Co. presided as chairman. The principal speaker was Caleb S. Taft, Assistant Plant Engineer of the Niagara Falls, N. Y., mill of the International Paper Co. Mr. Taft discussed "Steam Power Generation." His talk follows:

The purpose of this talk is to acquaint papermakers and the other members of industry present with the equipment, its use and operational peculiarities, and how that equipment is combined to produce a most essential service, the production of steam. It is hoped that production personnel will, by becoming more familiar with this equipment, be able to assist the steam department to furnish them with the service they need when they need it. I will describe a more or less typical steam plant, the plant at the Niagara Falls mill of the International Paper Co.

Starting with the coal-handling system, we have about one [illegible]d of an acre for storage. Because we have two types of [illegible]ilers burning different kinds of coal, we must split this storage [illegible]tween bituminous and anthracite. We store about 4000 tons [illegible]f hard coal with an average moisture content of 10% and a [illegible]t content of about 12,500 B.t.u. per lb. We also store about [illegible]000 tons of soft coal with about 5% moisture and 13,500 B.t.u. [illegible] lb. The coal is put to storage from cars by means of a coal [illegible]g. This drag also reclaims to a track hopper and is sometimes [illegible]sisted with a bulldozer.

C. S. Taft, International Paper Co., at the meeting of the Western District of the Empire State Section

The coal is taken from the track hopper to storage before the boilers by means of a skip hoist. This hoist will put up about 25 tons per hr. We have about 120 tons storage for hard coal before the boilers and about 144 tons for soft coal. We use about 2000 tons of hard coal per month during the Winter and about 4000 tons per month during the Summer. We also use about 1500 tons of soft coal per month year round.

Our old boiler house is a brick and steel building housing eight B & W Marine type boilers rated at 290 hp. These are equipped with Coxe traveling grate stokers and air preheaters. They generate steam at 130 p.s.i. and 450°F. total temperature and they operate at about 72% efficiency. We also have one new B & W Type F water wall boiler rated at 60,000 lb. per hr. This boiler has an economizer rather than an air preheater and is also equipped with a dust collector. The boiler is fired by a spreader type stoker and is controlled by a Hagan control system. The controls proportion and control the coal and air to the boiler to maintain the desired steam production. We have Bailey meters to measure the steam flow, air flow, draft readings, and also a smoke recorder for the stack gas. All boilers have a Cochrane continuous blowdown system for controlling boiler water solids and alkalinity. They also have chemical feed treatment by Betz. The water level in the new boiler is controlled by a Copes feedwater regulator and the boiler is equipped with Diamond soot blowers for tube cleaning. The feed pumps are rated at 200 g.p.m. at 1270-ft. head.

The feedwater heater is of the jet deaerating type and the water softeners are of the zeolite type. We also have an accumulator which is a large tank for steam storage.

The steam from the 60,000-lb. per hr. boiler is at 400 p.s.i. pressure and 600°F. total temperature. We reduce this steam through a Westinghouse 1500-kw. by-pass turbine-generator to 135 p.s.i. generating about 1000 kw. of electrical power at 440 v., 3 phase, 25 cycle. We also have an automatic desuperheating station to reduce the steam to 135 p.s.i. pressure and 450°F. temperature in case of turbine shutdown.

The steam distribution to the mill is at two pressures, 135 and 40 p.s.i. The 135-lb. steam comes from the old boilers and the by-pass turbine. Part of it is sent directly to the mill to the paper machine drive turbines. There are six paper machines with turbine drives. These drives consume about 50,000 to 60,000 lb. of steam per hour reducing the steam to 40 p.s.i. and 360°F. temperature. The rest of the 135 lb. steam is sent through a spill-over type valve which maintains the header pressure at 135 per p.s.i. Between this valve and another valve which regulates the pressure in the 40-lb. mill main we have the accumulator. The accumulator stores steam in the form of condensate at the saturation temperature for the pressure in the accumulator. The more condensate in the tank the higher the temperature and pressure. The accumulator pressure varies from 40 to 135 lb. depending on the amount of steam in storage.

The accumulator was originally installed because the old boilers could not change a load rapidly and some means was required to even out the variations in load from the peaks and valleys in steam demand by the pulp and paper mills. The pulp mill, for instance, may pull at a rate of 50,000 lb. per hr. and a short time later may be pulling at a rate of very nearly 0 lb. per hr.

The paper machines use approximately 50,000 lb. of steam per hr. for drying paper. The wastepaper pulp preparation system uses about 40,000 lb. per hr. during the day and about 15,000 lb. per hr. for the second and third shifts. We have a regulating valve in the 40-lb. mill main to the pulp mill to limit the flow to the pulp mill. This is necessary to maintain the required pressure for drying paper on the paper machines at all times. In other words when the pulp mill starts to use so much steam that the pressure drop through the main becomes excessive this valve starts to close limiting the steam flow and therefore, the pressure drop.

The steam used in the pulp mill is consumed in the process, however, the steam to the paper machines, unit heaters, and wherever possible is reclaimed in the form of condensate at the large storage tank in the paper mill. We must therefore, provide make-up water to the boilers for steam generation. This amounts to about 35% make-up.

The make-up water from the mill water system first goes to the Zeolite water softener to remove hardness. The water then travels to a heat exchanger, gaining heat from the continuous blowdown system. The water then goes to the vent condenser on the feedwater heater gaining further heat. It then travels to the condensate tank through a float control valve to join the condensate. This mixture is pumped back to the boiler house to the feedwater heater for heating and deaerating.

The water in the heater is sprayed through valves to a steam chamber. The droplets are heated to the saturation temperature for the pressure in the heater. The droplets then fall to the entering steam jets, the droplets being further scrubbed releasing almost all gases. The water then falls to a storage tank below the heater. The heater operates at about 9 lb. pressure and the water leaves the tank at about 230°F.

The steam and gases from the heater go to the vent condenser where the steam is condensed and the gases escape to atmosphere. The primary task of the heater is to remove oxygen from the water.

From the heater the water goes to the feed pumps and thence to the boilers. This water contains a certain amount of solids and is alkaline. The steam leaving the boiler is not alkaline and has no solids. Therefore there is a build-up in the boiler of the alkalinity and solids. To control this we continually blow down about 5% of the boiler water.

At the head table: Fred Andrews, International Paper Co.; G. K. Storin, Niagara Alkali Co.; William Barrett, Carborundum Co.; C. S. Taft, James Forsythe, and Robert Crockett, International Paper Co.

It is most important to reclaim as much as possible of the heat content in the water. For instance in the 400-lb. boiler the water in the boiler has a heat content of about 429 B.t.u. per lb. By reducing this water through the continuous blowdown control valve to 40 p.s.i. we are able to flash about 20% of this water into steam at the lower pressure. The water left then has a heat content of about 256 B.t.u. per lb. This water is run through a heat exchanger to heat the make-up water and then runs to sewer at about 80°F.

We maintain quite close control over the chemical properties of our boiler water in order to avoid carryover in the steam and scale formation on the tubes. We also wish to avoid pitting or corrosion of the tubes and drum. This is done by testing samples taken of the blowdown water varying the rate of feed of the chemicals to the incoming water and the rate of blowdown in accordance with these tests. In the immediate future we will put in one more 60,000-lb. per hr. boiler and perhaps in the more distant future an additional 60,000-lb. per hr. unit and an additional generator for electric power.

Empire State

Central District

The February 6 meeting of the Central District of the Empire State Section was held at the University Club, Syracuse, N. Y., with 78 persons present. The chairman, H. D. Cook, introduced E. C. Jahn, of the New York State College of Forestry, Syracuse, N. Y., who began the technical program by describing the contributions of the Empire State Paper Research Associates at the College of Forestry to pulping. This led to Robert M. Husband's talk on high yield pulping, with hardwood pulping being discussed also. Professor F. W. O'Neil concluded the program with a short talk on semichemical pulping and the Chemigroundwood process.

S. Earll Church, *Secretary*

The March 6 meeting of the Central District of the Empire State Section was held at the University Club with 73 persons attending. H. D. Cook, chairman, introduced the men at the head table and urged those present to prepare technical papers to be presented in competition next year. No competition is scheduled this year.

The matter of nominating a vice-chairman for the Empire State Section was considered, but no nomination was made.

Mr. Cook introduced Ferdinand Kraft, Technical Director of Marathon Corp., Marathon, Ont., Canada, who introduced John Spalding, Process Engineer, Marathon Corp., Oswego, N. Y., who discussed "The Manufacture and Use Requirements of Bread Wraps." Mr. Spalding's talk follows:

Mr. Chairman, Guests, Ladies, and Gentlemen: Some of you, no doubt, may be wondering why I have selected this particular subject to talk about tonight. First, as far as I know, this grade of paper is not manufactured in this area, and I thought a description of its manufacture might be of interest from a purely informational standpoint. Second, the number and diversity of operations which comprise the manufacture of this grade make it an interesting one from a technical standpoint. And third, breadwrapper illustrates in a typical way the requirements imposed upon a sheet of paper which serves as a packaging material.

It might be said that a packaging material has a dual functionability. First, it serves to enclose and protect the contents of the package, and second, it is supposed to help sell the contents in competition with similar products in close proximity. In my talk tonight I hope to use breadwrapper as a case history illustrating the demands which these requirements impose upon the manufacturing processes and the ingenuity of those engaged in building the desired properties into the sheet.

At the outset I might say that there are three principal types of breadwrapper stock being used by the baking industry: cellophane, transparent waxed glassine and sulphite, and printed opaque. My remarks will be confined to the latter type as it is the one with which I am most familiar, and also is the most widely sold. A brief introductory description of the manufacturing operation follows: the sheet consists of a 25-lb. base stock, waxed to a finished weight of 38–40 lb. Most of it is made upon straight Yankee or Yankee-fourdrinier machines, and most of it is machine coated. However, substantial tonnages are run on plain fourdrinier units and likewise substantial tonnages are coated off the machine in a separate coating process. Most of it is also printed on rotary letterpresses, although for pictorial designs the rotogravure process is often used. Some manufacturers print on the uncoated side of the sheet, in which case the coating serves only to enhance the appearance of the sheet after waxing whereas other manufacturers do print on the coated side of the sheet. In some instances the paper may be supercalendered before printing, particularly where a pictorial design is to be applied. After printing, the web is waxed, rewound and slit into small rolls, and shipped to the baker. The baker may employ one of several wrapping machines which unwind the roll, cut the web, wrap the bread, seal the ends of the loaf, and apply the end label.

F. W. O'Neil, Robert M. Husband, and Edwin C. Jahn, College of Forestry, State University of New York

In our discussion of the properties of the finished wrapper I have segregated the purely functional requirements from those which acquire importance only because the trade demands them in the belief that they will help sell more bread through their sensory appeal. In this latter group I would include the following:

1. An appealing and eye-catching over-all appearance and design. The design serves as a trademark as it identifies to the buying public the products of an individual baker, and also it is desirable that the design be sufficiently striking so that its individuality will be maintained when viewed in close proximity to other competitive breads. A corollary requirement here is that the sheet be well printed.
2. The sheet must have a high brightness and opacity after waxing and a uniform look-through. Variations in the color of the crust must be obscured, and there must not be even the remotest subconscious impression that the crust may be dark or burned.
3. The sheet must likewise have a smooth, glossy appearance. This imparts both a sensory and psychological appeal which is familiar to all of us but is nonetheless difficult to analyze.
4. The sheet must be soft and yielding to the touch lest it destroy the impression of freshness when the loaf is grasped.

Among the purely functional requirements I would list:

1. Sufficient strength and ability to withstand impact so as to not puncture or tear when the loaves are handled in transit or in response.
2. The rolls must not block in storage. By this I mean that adjacent layers of the paper must not stick together.
3. The sheet must not be too stiff or too limp or it will not permit high-speed operation on the wrapping machine.
4. The sheet must be odor-free.
5. It must have good sealing strength and good sealability.
6. It must protect the bread from loss of moisture.
7. After a few slices have been removed from the loaf the wrapper must be capable of being folded or rolled so as to prevent the remainder of the loaf from drying out.
8. After its use as a breadwrapper, it is desirable, if it can still find utility as a sandwich-wrap or other domestic use as a waxed paper.

These latter requirements should not be minimized as they definitely limit competition from cellophane as a breadwrapper.

(Now at this point, I thought it would be of interest to show a film which our sales people have taken on the merchandising of bread, after which I shall go through the manufacturing processes and attempt to highlight those points which are important in regard to their effect upon the properties of the finished wrapper which we have just been mentioning.)

Now that we have seen the merchandising of the product let us go through the manufacturing operations. As has been mentioned a fairly tough sheet is required. For this reason we employ a substantial proportion of bleached kraft pulp in the furnish along with sulphite and/or hardwood fiber. Some titanium dioxide is used as a filler to impart opacity.

The stock is fairly well beaten and wet-end conditions on the

fourdrinier are set to give a well-formed, well-closed sheet as free from pinholes as possible.

If the sheet is run on a Yankee or Yankee-fourdrinier machine the conditions prevailing at the nip between the pressure roll and the Yankee drier face are of extreme importance. The nip pressure and the moisture content at the nip must be rigidly controlled. Within limits, increasing the nip pressure and the moisture content has the following effects.

First, the drying rate is improved because of more intimate contact with the drier face, second, the Gurley porosity and density of the sheet is increased markedly, and third, the smoothness of the machine glazed side of the sheet is improved. With the proper combination of conditions it is possible to make a sheet having a printing surface approaching that of a supercalendered sheet in its ability to be printed with a pictorial design in half-tones from a 120-line screen. The advantages of this costwise are obvious.

Increasing the porosity of the sheet is desirable for many reasons. First, if, as many manufacturers do, the sheet is machine coated as the sheet passes over the Yankee drier, the strike-through of the coating onto the drier face is reduced. Second, strike-through of the ink onto the impression cylinders of rotary press is reduced. This strike-through can build up on the impression cylinders and cause an increase in printing pressure which in turn results in a variation in the printed appearance. Third, increasing the porosity and density of the sheet reduces the wax-penetration into the sheet which results in a higher waxed opacity and a reduction in stiffness.

Some manufacturers who have a straight Yankee machine use two pressure rolls to gain some of the advantages mentioned above.

In order to have a uniform nip pressure across the Yankee face the pressure roll must be properly crowned. One method successfully used to establish the proper crown is to cut the entire width of the web into adjacent 1-in. strips, and check the printability on a proofpress of each strip. The roll is then ground and reground until a uniform printability across the web is obtained.

Inasmuch as many manufacturers machine coat at the Yankee drier it is appropriate to discuss the coating process at this point. Coating of breadwrapper stock came into practice as a result of the demand to improve the waxed appearance of the sheet. The weight of coating applied will vary from mill to mill but most apply in the range of 2 to 5 lb. per ream. The use of pigments of high refractive index is universal and they may or may not be used in combination with clay. Starch is the most commonly used adhesive although it is sometimes used in combination with other well-known coating adhesives. Additives to improve flexibility, water resistance, leveling index, etc., are commonly used. The rheological properties of the coating are of course controlled to best fit the particular coating process and equipment employed. Inasmuch as the primary function of the coating is to improve the waxed appearances of the sheet, it is of course important that no visual defects arise from the coating application itself. Most manufacturers apply the coating to the wet web as it passes around the Yankee drier using the Consolidated process or modifications thereof. At least one manufacturer applies the coating to the dry web by the Champion process, followed by driers. Other proprietary processes are used for off the machine coating. One interesting installation uses the Trist process, coating a 190-in. web at 2000 f.p.m.

The control of opacity is important both from an economic and quality standpoint. The baker is only interested in the opacity of the waxed sheet as he receives it, and while waxing techniques can affect this markedly, the primary point of control is at the paper machine or coating unit. Most producers employ titanium dioxide both as a filler and in the coating. If we were concerned with opacity alone we would find that a given content of titanium dioxide would be more effective if confined to the coating. However, if titanium dioxide is omitted from the base sheet the visual appearance of the waxed sheet is impaired because the pattern of the coating film shows up on waxing.

Conversely, if the titanium dioxide is used entirely as a filler and omitted from the coating the formation pattern shows up on waxing. If thus has been found necessary to arrive at an optimum distribution of the titanium dioxide between the base sheet and coating. In practice this amounts to using approximately 1% in the base sheet and adjusting the coating formulation and weight to end up with the desired opacity.

Under the auspices of the Sulphite Paper Manufacturer's Association, a standard method of checking the waxed opacity of the sheet has been adopted. This consists of taking a strip of the paper and hand-waxing it under prescribed conditions which insure virtual saturation. The opacity of the hand-waxed strip is then determined as contrast ratio on the Bausch & Lomb spacimeter. This procedure is employed as a routine control method for controlling coating weight, and has recently been issued as TAPPI Routine Control Method No. 224.

After the sheet leaves the paper machine it is subjected to the various finishing operations which comprise printing, plasticizing, calendering, and waxing. The sequence of the operations may differ from mill to mill, but we will discuss then in the order given above. Most breadwrapper is printed on five or seven color rotary letter-presses at speeds up to 1400 f.p.m. The use of multicolor presses increases the flexibility of scheduling in that more different designs can be printed in combination across the web. Linseed oil inks are often used as well as glycol base or "Hi-dry" inks. It is important that there be no residual ink odor in the finished sheet. The sheet is treated before being reeled up on the press to prevent offset. The antioffset treatment may consist of dusting with dry mobile starch, spraying with wax, or applying a light film of wax on the back side of the sheet. The printed rolls are stored until the ink is sufficiently dry to permit further processing.

In recent years there has been a trend to the use of pictorial designs. In some instances the rotogravure process is employed to achieve a more mellow and life-like effect. In some instances the sheet is also supercalendered before printing to gain better reproduction. Also, considerable tonnages are printed on the coated side of the sheet to gain the advantages of faster ink drying, better reproduction, and some saving in ink application.

The plasticizing operation consists principally of adding water to the sheet. The water may carry with it a plasticizing or softening agent. The purpose of this operation is to improve the ability of the sheet to mold to the loaf in the wrapping operation, to improve the sealability of the sheet by reducing the tendency to spring back after the seal is made, to improve the strength of the seal, and to soften the sheet so when the loaf is squeezed it will feel fresh. This operation may precede waxing or may be an integral part of the waxing operation.

It is also customary to calender the sheet before waxing in order to control its density. If the sheet is too bulky excess wax soaks into the sheet and increases the stiffness and reduces the opacity, and is uneconomical, as excess wax in the sheet contributes little to the protective properties. Also, if the sheet is too bulky the sealability is adversely affected. The seal is made on the wrapping machine by pressing with hot plates kept at temperatures in the range from 350 to 450°F. which affects a cohesion of adjacent films of surface wax. If the sheet is too bulky some of the surface wax is driven into the sheet, leaving too little on the surface to make the seal. On the other hand, if the sheet is too dense the sealability suffers as the adhesion between the wax film and the paper surface is reduced.

The waxing operation consists, essentially, of ducking the web in a bath of molten wax, squeezing off the excess wax by passing the web through a pair of squeeze rolls, passing the web through a bath of cold water, and removing the surface moisture.

Paraffin wax is the basic ingredient of the wax formulation. Additives such as polyethylene may be used to improve the gloss and increase the blocking temperature, and microcrystalline waxes or synthetic elastomers may be added to increase the sealing strength. The conditions at the waxer critically affect the appearance of the sheet and must be arrived at empirically. The important variables are the wax temperature and viscosity, the crown, plastometer value, and nip pressure of the squeeze rolls, the temperature of the sheet entering the water bath, the water bath temperature and surface tension, and the speed of the web. The sheet properties which are affected by the conditions at the waxer are the amount of wax taken up by the sheet and retained on the surface, gloss, freedom from flow lines or crows feet, opacity, seal strength, the blocking temperature, the resistance to pressure blocking, the maintenance of gloss on storage, and the water vapor transmission rate. It is obvious that there is an infinite number of possible combinations of conditions and it is only through years of experience in the art of waxing that the optimum combination is reached. Also it is essential that rigid control be maintained.

Likewise the mechanical features which govern the path of the web as it passes through the waxing unit, and which govern the circulation of wax and cooling water can profoundly influence the appearance of the sheet as well as the efficiency of the operation.

The water adhering to the sheet as it emerges from the cooling bath may be removed by doctors, vacuum nozzles, or by transfer to wringer rolls.

After waxing, the jumbo rolls are rewound, slit, and wrapped for shipment to the individual bakers.

In conclusion it is hoped that this discussion has served to illustrate the variety and intensity of effort that goes into the manufacture of a seemingly commonplace article of commerce. There may be some who feel that the application of this effort and the accompanying use of materials to simply improve the appearance of the product represent a dissipation of manpower and resources. In rebuttal I can only say that we are here dealing with but one small facet of free competition and that free competition has been the source of America's strength.

S. Earll Church, *Secretary*

Analysis of Calcium Sulphate Fillers

Proposed Revision of TAPPI Official Standard T 615 m-44

(THIS STANDARD IS UNDER THE JURISDICTION OF THE NONFIBROUS MATERIALS TESTING)

VARIOUS forms of calcium sulphate are used as paper fillers. Gypsum is a natural mineral having the chemical formula $CaSO_4.2H_2O$. It may be ground and used directly as a filler or it may be calcined to remove the water of crystallization and then ground. The ground uncalcined mineral has the form of plates Pearl Hardening is an artificial, hydrated calcium sulphate made by precipitation from a solution of $CaCl_2$ with Na_2SO_4. It exists in two forms: either flat, tabular crystals or small, needle-shaped crystals. Other names for prepared calcium sulphate fillers, either hydrated or anhydrous, are Pearl White, Crown Filler, Pearl Finish, Alabastine, etc. Calcium sulphate from natural sources is usually slightly alkaline; that made artificially may contain acid.

SAMPLING

If packed in bags or barrels, take samples at random from 10% of the packages, preferably with a trier. If shipped in bulk, take samples at regular intervals during unloading, or, if this is not possible, in such a way as to obtain a representative sample of the entire shipment. In any case the gross sample of a bulk shipment shall be not less than 100 lb. Thoroughly mix the gross sample and if necessary quarter down to a suitable size, about 500 grams, and transfer to a stoppered container.

REAGENTS

Of the following reagents, *A* is required for determining free acid and the others for iron oxide.

A. *Sodium Hydroxide*, 0.01 *N*. Accurately standardized. This may be conveniently prepared by diluting 100 ml. of 0.1 *N* NaOH to 1 liter in a volumetric flask with freshly boiled and cooled distilled water.

B. *Hydrochloric Acid*, conc. Free from iron.

C. *Potassium Permanganate*, 0.1 *N*. Accurately standardized.

D. *Potassium Thiocyanate*, 2% solution.

E. *Standard Iron Solution.* Dissolve 0.500 gram of ferrous ammonium sulphate, $Fe(NH_4)_2(SO_4)_2.6H_2O$, in 50 ml. of water and add 20 ml. of dil. H_2SO_4 (1:1). Warm slightly and add $KMnO_4$ solution drop by drop until the $FeSO_4$ is completely oxidized, as shown by a permanent pink color. Cool and dilute with water to 1 liter. Each ml. of this solution contains 0.0001 gram of Fe_2O_3.

COLOR

The color is usually compared to that of a standard sample mutually agreed upon. In making color comparisons both the sample and the standard shall be under similar conditions as to content of free moisture.

Dry about 10 grams of the sample and of the standard thoroughly in an oven at 100 to 105°C. for at least 4 hr. (preferably overnight). Grind to break up any lumps and spread on a piece of smooth paper. Beside it spread an equal amount of the dried standard which has been similarly treated. Move one pile toward the other until they are in contact and press them down with a polished stainless steel spatula to give a smooth surface. If the two samples are of the same color, it will be impossible to see any line of demarcation between them.

GRIT (SIEVE TEST)

Weigh out 200 grams of the sample and place on an 80-mesh sieve. Wash with a slow stream of tap water from rubber tubing until the water leaving the screen is clear, using a camel's hair brush to break up any large lumps. Use only the minimum amount of water necessary, to avoid dissolving the filler. Dry the material remaining on the screen at 100 to 105°C., transfer to a suitable small container, such as a tared watchglass, and weigh. Calculate the percentage retained on the screen and report as grit.

If desired, place the dried grit on a slide and examine under a microscope, noting particularly the presence, color, and proportion of mica, quartz, and any other unusual substances.

TOTAL WATER

Weigh accurately 1 gram of the sample in a weighed platinum crucible and ignite over a Meker burner to constant weight. Report the percentage loss in weight as the total water.

FREE MOISTURE

Assuming all the ignited residue from the determination of total water to be $CaSO_4$, multiply this by the factor 1.265 to convert it to $CaSO_4.2H_2O$. If the figure thus obtained on a percentage basis is less than 100, the difference between the percentage of $CaSO_4.2H_2O$

and 100% shall be reported as free or mechanical moisture. If the figure obtained is greater than 100%, the material is a calcined product. In such a case the approximate amount of free moisture may be determined by drying a 1-gram sample to constant weight at 100 to 105°C.

COMBINED WATER

The difference between the total water and the free moisture shall be reported as combined water.

FREE ACID

Weigh accurately 10 to 15 grams of the sample into a 250-ml. casserole or beaker. Add 100 ml. of water and a few drops of methyl orange indicator and stir well. If the solution is pink, titrate with 0.01–NaOH until the pink color just changes to yellow. Calculate the titration to percentage of HCl.

Calculation: 1 ml. 0.01 *N* NaOH = 0.00036 gram HCl

IRON OXIDE

Weigh accurately 1 gram of the sample into a 100-ml. casserole or beaker and add about 15 ml. of conc. HCl. Warm the mixture on the steam bath and add slowly sufficient distilled water to bring the sample into solution. Usually about 25 ml. are required. Transfer to a 100-ml. Nessler tube and add 0.1 *N* $KMnO_4$ solution drop by drop until a permanent pink color is produced. Then add 10 ml. of 2% KSCN solution and dilute to the 100-ml. mark on the tube. Mix thoroughly and compare the color at once with that obtained with standard iron solution prepared in the same manner in another Nessler tube similar to that containing the sample. To this tube add the same amounts of conc. HCl and 2% KSCN solution as were used for the sample, and dilute the mixture to the 100-ml. mark with water. Then add the standard iron solution carefully from a buret, drop by drop, stirring after each addition, until the color matches the color of the solution of the sample. From the number of milliliters of standard solution required calculate the percentage of Fe_2O_3 in the sample.

ADDITIONAL INFORMATION

This Standard was originally titled Analysis of Mineral Fillers and covered the testing of clay as well as calcium sulphate fillers. The testing of clay is now covered separately. Otherwise this Standard has not been essentially changed.

Analysis of Starch and Starch Products

*TAPPI Tentative Standard T 638 m-53**

(THIS STANDARD IS UNDER THE JURISDICTION OF THE NONFIBROUS MATERIALS TESTING COMMITTEE)

This method covers the sampling of starch and starch products, and determinations of moisture, ash, cold-water soluble matter, pH value, foreign material, and protein. For the determination of viscosity *see* T 637 sm.

Starch is a carbohydrate occurring commercially as a white or buff-colored powder or granular material. Starch products include chemically modified forms of starch, impure starches such as cereal flours, and starches admixed with other substances.

SAMPLING

Obtain a representative sample of the shipment weighing at least 750 grams. The number of bags sampled shall be equivalent to the square root of the number in the lot, but not less than 10 nor more than 30.

If the samples are to be taken while the material is still in the car, a cylindrical metal trier provides an efficient means of sampling without severe damage to the bag, which is usually made of kraft paper. The trier consists of a long metal cylinder $^1/_2$ in. in diameter, having in the side a slit 16 in.long and about $^1/_2$ in. wide. A tab of gummed paper may be pasted over the hole caused by the trier, to avoid spillage. From each bag to be sampled, extract a core from one corner of the top diagonally to the center of the bag by means of the trier. If the samples are to be taken as the product is used, the trier will not be necessary.

Immediately place the sample in an air-tight container and keep the container sealed between samplings. Thoroughly mix and quarter down the samples obtained as above to a representative sample of suitable size for laboratory use. For a single determination of all tests listed below, a minimum sample of 335 grams is necessary.

APPARATUS

The special apparatus required for a complete analysis consists of:

1. *Analytical Balance.* Sensitive to 1 mg.
2. *Drying Oven.* Preferably equipped with forced air circulation.
3. *Glass-Electroed pH Meter.* Of conventional type, calibrated.
4. *Waring Blendor,* or an equivalent high-speed mixer.
5. *Sieve,* 200-mesh wire.
6. *Buret.* A 50-ml. Machlett buret graduated to 0.1 ml. is especially convenient.
7. *Kjeldahl Flask,* 800-ml.
8. *Kjeldahl Digestion Apparatus.*

REAGENTS

Special reagents are required only for the determination of protein.

* This method has been approved as a tentative standard by the Standards Committee. Criticisms are earnestly requested and should be sent to R. G. Macdonald, Secretary, Technical Association of the Pulp and Paper Industry, 122 E. 42nd St., New York 17, N. Y.

MOISTURE

If the material contains matter other than water which is volatile at the prescribed drying temperature, suitable correction must be made.

Place a flat weighing dish and cover (aluminum is satisfactory) on the pan of the balance, weigh them empty and then weigh accurately to the nearest mg. about 5 grams of the sample into the dish. Place the dish and contents in the drying oven and heat to constant weight, which will require approximately 3 hr., if the conventional type of oven with air circulation is used at 100 to 105°C. Remove to a desiccator and cool for 30 minutes. Cover the dish and weigh to three decimal places. Calculate the percentage loss in weight of the original material to the nearest 0.1 and report as moisture (loss in weight at 100 to 105°C.).

ASH

Weigh accurately (to 1 mg.) about 5 grams of the sample into a tared porcelain, silica, or platinum crucible. Heat carefully with a Bunsen burner until the starch is charred. After danger of frothing is past, complete the ashing either over the burner or in a muffle furnace at about 550°C. (dull red). When incineration is complete, as evidenced by a white ash, place the crucible in a desiccator until cool (30 min.) and weigh. Calculate the weight of residue to percentage of the moisture-free specimen to the nearest 0.01, and report as ash.

COLD-WATER SOLUBLE MATTER

Weigh 10 ± 0.1 grams of the sample as received into a 200-ml. large mouthed volumetric flash, preferably of the Kohlrausch type, and add 150 ± 1 ml. of distilled water at 21°C. (70°F.). Mix thoroughly and let stand at room temperature (21 to 23°C.) for 2 hr. with occasional shaking. Make up to volume, mix thoroughly, and filter the contents through double filter paper, discarding the first 25 ml. of the filtrate. Pipet an aliquot of 50, 25, or 10 ml. of the filtrate, depending on the solubility of the specimen, into a flat, tared, porcelain or glass evaporating dish of about 70 ml. capacity, and evaporate to dryness on a steam bath.

Note: In the case of starch products with very high water-soluble content, the aliquot should be adjusted so that there will be less than 0.5 gram of solids, or the residue will be very difficult to dry.

Transfer to an oven and heat for 1 hr. at 100 to 105°C., cool in a desiccator for 30 min., and weigh in a covered container to three places. Repeat the heating and weighing at half-hour periods until the weight is constant.

From the aliquot used calculate the percentage of water-soluble matter and report to the nearest 0.1.

pH VALUE

This method is for the electrometric measurement of pH values of aqueous solutions or suspensions of starch and starch products.

1. *For Dry Starch.* Weigh 10 ± 0.1 grams of air-dry starch into a clean 250-ml. beaker. Add 20 ml. of distilled water and mix thoroughly. After 5 min., determine the pH value with the pH meter.

2. *For Cooked Starch.* For thin-boiling starches, mix 10 ± 0.1 grams with 200 ml. of distilled water. For thick-boiling starch, mix 5 ± 0.1 grams with 200 ml. of distilled water. Place on a steam or a hot-water bath and stir until pasted. Continue heating for 10 min. Cool to 25 ± 5°C. (77 ± 9°F.) and determine the pH value of the cooked starch with the meter.

Report the pH value to the nearest 0.1 unit.

FOREIGN MATERIAL

For the purpose of this method, foreign material is considered to be that portion of the starch sample which will not pass through a 200-mesh screen after dispersion in cold water.

Add 300 ml. of tap water to the mixer. Weigh out 300 grams of the sample and add it to the water in the jar, keeping the powder off the sides. Mix for 4 min. Screen the sample through the 200-mesh screen, using tap water as necessary. Finally, using a wash bottle, wash the residue with hot (about 90°C.) distilled water on a tared filter paper.

Note: To determine the tare weight of the filter paper, weigh several filter papers in the air-dry condition, heat at 100 to 105°C. for 2 hr., place separately on the balance while hot, and quickly weigh to the nearest 5 mg. Calculate the average moisture content and use this to correct the air-dry weights of the tared filter papers.

Dry the filter paper and residue in the oven at 100 to 105°C. for two hours, and weigh hot to the nearest 5 mg. Repeat the drying and weighing for half-hour intervals until the weight is constant.

Divide the weight in grams of the residue by 3, to obtain the weight per 100 grams of the sample, and report the result as a percentage of the original sample to the nearest 0.01.

PROTEIN

This method is for a quantitative determination of protein in starch and starch products. It is particularly applicable to starch products in which the amount of protein is relatively small.

Reagents

The special reagents required for this determination are given below. All reagents should be low in nitrogen, or of C.P. grade.

A. *Sulphuric Acid,* concentrated. Sp. gr. 1.84.

B. *Potassium Sulphate–Mercuric Oxide Mixture.* Mix in the proportion of 15 to 18 grams of K_2SO_4 to 0.6 to 0.7 gram of HgO.

C. *Granulated Zinc.*

D. *Alkaline Potassium Sulphide Solution.* To liter of 40° Bé. sodium hydroxide solution (485 grams of NaOH per liter) add a solution of 12 grams of K_2S in 20 ml. of water.

E. *Hydrochloric Acid,* 0.01 *N.* Accurately standardized.

F. *Boric Acid,* 4%. Dissolve 40 grams of boric acid in water and dilute to 1 liter.

G. *Indicator Solutions.* 0.1% solutions each of methyl red and bromcresol green in 95% alcohol.

Procedure

Determine the moisture content of the starch as previously described. Weigh accurately the equivalent of 5 grams of moisture-free sample on an analytical balance to the nearest milligram, using a piece of nitro

gen-free filter paper. Wrap the paper around the sample and place in an 800-ml. Kjeldahl digestion flask. Add 12 to 15 grams of reagent B and then 45 ml. of conc. H_2SO_4. Place the flask and contents on the digestion rack and heat for 1 to $1^1/_2$ hr. Adjust the flame so that the sample does not froth up into the neck of the flask. Swirl the contents of the flask several times during the digestion period so that all the material will be washed down to the acid and be properly digested. The solution should be practically colorless at the end of the digestion period.

When digestion is complete, remove the flask from the rack to cool. When cool, add 400 ml. of cold water, mix well, and add a few pieces of granulated zinc to the flask. Pour slowly down the side of the flask 100 ml. of reagent D. Connect the flask immediately to a condenser leading into a 500-ml. flask containing 50 ml. of the boric acid solution, to which has been added 0.5 ml. of mixed indicator solution made by mixing indicator solutions G together in the ratio of 1 part methyl red to 5 parts bromcresol green. Distill over 250 to 300 ml. from the reaction flask.

Finally, titrate the distillate with 0.01 *N* HCl to the end point (neutral violet), and from the titration calculate the amount of nitrogen and protein in the sample. Run a blank determination using the reagents in the amounts specified in the method.

Calculation: 1 ml. 0.01 *N* HCl = 0.00014 gram nitrogen
= 0.000875 gram protein

Report the result as percentage of protein (N × 6.25) to the nearest 0.01, based on the moisture-free sample, after correction for the blank determination.

Moisture in Paper by Toluene Distillation*

TAPPI Tentative Standard T 484 m-53

(THIS STANDARD IS UNDER THE JURISDICTION OF THE CHEMICAL METHODS COMMITTEE)

This is a rapid and accurate method for the determination of moisture in comparatively small samples, but is not intended to be used for ordinary papers in place of the oven-drying method, T 412 m. It is recommended for materials (*1*) such as waxed papers, varnished papers, etc., in which moisture cannot be determined by the oven-drying method owing to the presence of fusible constituents or the probable loss of volatile constituents.

APPARATUS

1. *Distillation Apparatus.* This consists of a glass flask, heated by suitable means and provided with a reflux condenser discharging into a trap which is connected to the flask. (*See* Fig. 1.) The connections between the trap and condenser and flask shall be ground-glass joints. The trap serves to collect and measure the condensed water and to return the solvent to the flask. Before use, the condenser and the receiving tube shall be thoroughly cleaned with soap and warm water, rinsed well, then treated with hot cleaning solution (a mixture of 10 ml. of saturated potassium bichromate solution and 990 ml. of conc. sulphuric acid) and finally thoroughly washed and dried.

The glass flask (*A*) shall be of the short-neck, round-bottom type (either ⅎ 24/40 or 45/50 joints are suitable), having a capacity of approximately 1 liter.

The condenser (*C*) is of the West type. (A ⅎ 24/40 joint, 30-cm. jacket, water-cooled joint is suitable.) The end of the condenser to be inserted in the trap is ground off at an angle of 30° from the vertical axis, and the tip of the condenser tube when inserted in the trap extends about 7 mm. (0.25 in.) above the surface of the liquid in the trap after the distillation conditions have been established. Accurate centering of the tip eliminates to a very large extent the collection of droplets of water on the sides of the trap.

The top of the condenser is fitted with a standard buret cap or a small test tube. This is to prevent the condensation of atmospheric moisture, particularly in the summertime, during the distillation.

The trap or receiver (*B*) is of the Bidwell-Sterling type, made of well-annealed glass and graduated from 0 to 10 ml. in 0.1-ml. graduations. (ⅎ 24/40 and 45/50 joints are suitable.) The vapor tube between the glass flask and the trap reservoir should have an inside diameter of 10 mm. and be lagged with suitable insulation, such as asbestos tape or several layers of electrician's tape, subsequently lacquered or shellacked. The insulation, although thin, greatly reduces the condensation of the distilling liquid in the vapor tube, resulting in a lower bath temperature to produce the required amount of refluxing in the condenser. Although for most purposes the 10-ml. trap is suitable, for small or very dry samples where less than 2 ml. of water are collected, a 2-ml. receiver with finer gradations should be used.

2. *Caps for Cleaning.* Provision of ground-glass caps for the trap and condenser is an aid in the cleaning of the trap and condenser with hot cleaning solution, as they enable the trap and condenser to be filled with the agent and allowed to stand for the necessary time for effective cleaning.

3. *Source of Heat.* This is preferably an oil bath, although an electric heater or Bunsen burner may be used. An oil bath carries the heat uniformly to the flask. The level of the bath should be above the level of the distilling liquid in the boiling flask, since this reduces bumping.

CALIBRATION

Calibrate the graduated tube by adding measured volumes of water from a micropipet of known accuracy.

* This method has been approved as a Tentative Standard by the Standards Committee. Criticisms are earnestly requested and should be sent to R. G. Macdonald, Secretary, Technical Association of the Pulp and Paper Industry, 122 E. 42nd St., New York 17, N. Y.

Add a small quantity of toluene to the tube before calibrating, since its surface tension will affect the shape of the meniscus formed at the interface.

REAGENT

Toluene. The reagent used shall be U.S.P. toluene (b.p. 110 to 112°C.). This normally contains a small amount of moisture which must be removed before use. To do this add a few ml. of water to a quantity of the toluene and distill in the moisture apparatus until no more water collects in the trap.

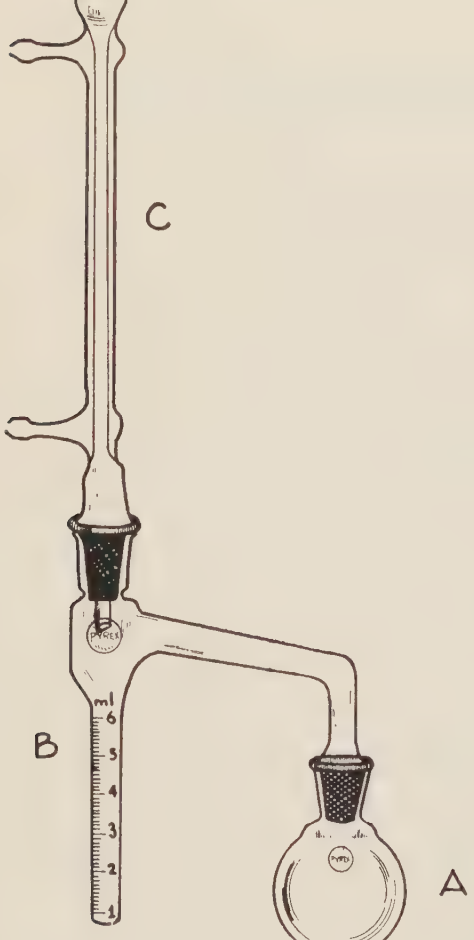


Fig. 1

The toluene may be used repeatedly unless some soluble, more or less volatile substance from samples is retained. In such cases, it may be recovered by distillation, retaining the portion boiling in the specified range.

TEST SPECIMEN

Observe the general precautions outlined in TAPPI Standard T 412 m. Place samples in tared airtight containers as soon as taken, so as to prevent changes in weight due to exposure, and weigh immediately. If, however, the samples were hot when taken, the con tainers with the enclosed samples shall first be allowe to cool and the air pressures inside and outside equa ized by momentarily opening and reclosing the lid, be fore weighing.

Note: With hot samples, some moisture condensation ma occur on the inside walls of the container. In such cases, th amount of condensed moisture should be determined from th loss in weight of the moist empty container after drying in a oven. Include the amount of condensed moisture so found i calculating the moist weight of the sample and add its volum to the water subsequently recovered in the distillation proces assuming that 1 gram of water equals 1 ml.

Keep samples in their containers to protect them from moisture change until the time of testing, whic should be as soon as possible.

It is desirable that the sample should have a mini mum moist weight of 50 grams and its weight should b so chosen that from 6 to 8 ml. of water will be collecte in the trap.

PROCEDURE

Before assembling the apparatus for the test, thor oughly clean the condenser tube and trap and dry by heating in an oven. While the glass is still warm, we the inner surfaces of the condenser and receiver with a small quantity of toluene in order to lessen the proba bility of water globules sticking to the glass surfaces This can be done conveniently by assembling the ap paratus and then pouring a quantity of toluene int the assembled apparatus, via the condenser tube.

Before assembling the apparatus, mark each ground glass joint with a No. 2 graphite pencil. Closure is then made with a few drops of toluene, and a firm seal se cured by turning the joints. In this way, the penci graphite is spread between the joint surfaces, enablin them to be easily separated on the completion of th test. The flask should contain about 500 ml. of tol uene.

Transfer the weighed sample as rapidly as possibl from its container to the flask. It is desirable, but no essential, that the sample be covered by the solvent A few glass beads or pieces of porous plate (oven-dry help to avoid bumping.

After reconnecting the apparatus, cap the condense loosely and start a stream of water through the con denser. Apply heat and so regulate that the condense tube immediately below the water jacket is just barel hot. A distillation rate of about 3 drops per sec. ha been found to be best and is continued until practicall no water is visible on any part of the apparatus excep on the trap bottom. This usually requires about 1 h Then increase the rate of distillation slightly to re move all traces of condensed water in the condense tube and continue the distillation until the water leve in the trap remains unchanged after a 10-min. interva

Note: If drops of water adhere to the side of the trap or con denser tube, they may usually be dislodged by rubbing wit a copper wire, the end of which is wound into a spiral slightl smaller than the inside of the trap. When drops are observe the wire may be passed down through the top of the condens tube without interrupting the distillation. The presence such drops indicates the use of dirty equipment, and anothe sample should be run if accuracy is desired.

After no further change occurs, estimate the volum

f water in the trap (without disconnecting the apparatus) to the nearest 0.02 ml. Correct the observation, if necessary, for any errors in the graduation of the trap. It is not necessary to wait until the distillate clears before reading the trap.

REPORT

Calculate the percentage of moisture on the original (moist) weight of the sample, and report as moisture by distillation method, to the nearest 0.1.

PRECISION

The method is accurate to ±0.1 ml. of water. What this represents in percentage accuracy depends upon the size of the sample and amount of water.

REFERENCE

Fetzer, W. R., "Determination of Moisture by Distillation," *Anal. Chem.* 23: 1062 (1951).

LITERATURE CITED

1. Committee Report, "Sampling and Testing Paper for Moisture Content," *Paper-Maker and British Paper Trade J.* 119: 32–40 (1950).

Viscosity of Starch and Starch Products

*TAPPI Suggested Method T 637 sm-53**

(THIS SUGGESTED METHOD IS UNDER THE JURISDICTION OF THE NONFIBROUS MATERIALS TESTING COMMITTEE)

This method is for measuring the viscosity of starch solutions or suspensions as determined on the Stormer viscometer of the Corn Industries Research Foundation. The viscosity is recorded automatically as a graph which gives viscosity characteristics during any desired period of cooking and cooling.

APPARATUS

1. *Corn Industries Viscometer* with water bath, as shown in Fig. 1. (This is manufactured by Hayes Scientific Appliances, Urbana, Ill.) The water bath in which the starch is cooked is electrically heated and the temperature is automatically controlled by a variable thermoregulator so that any preset temperature can be maintained constant. The dynamometer, which is of the pendulum type, is located in the recorder case. Supplementary weights are provides so that the recorder chart at full scale has four ranges of viscosity: 225, 450, 900, and 1800 gram-centimeters, respectively. These weights can be added or removed instantly without change in the calibration of the viscometer. This permits testing all starches over a wide range of concentrations. One advantage of this is that starches of very different viscosities can often be tested at the same concentration so that a direct comparison can be made of their properties.

2. *Container* of 1-liter capacity. An enameled graduate with handle is most convenient.

TEST SPECIMEN

A representative sample is required in accordance with the following table:

PROCEDURE

Determine the moisture content of the sample according to the procedure given in T 638 in.

Weigh out the equivalent of 10 ± 0.01 grams of moisture-free starch and transfer it to the liter beaker. Add sufficient distilled water at room temperature to make a total weight of 1000 grams for the starch and water. If 10 grams will not give a suitable reading, weigh out two or three other quantities to get the viscosity of 10 grams by extrapolation.

Place the viscometer cup in the water bath heated to 92°C., unless results at some other temperature are desired. Insert the stirring device, swing the viscometer head in place over the cup, and attach the stirrer to the shafts in the viscometer head. Start the stirrer motor. Immediately before pouring the starch-water mixture into the viscometer cup, stir the slurry briefly with a stirring rod to suspend the starch uniformly. At the same time that the mixture is poured into the viscometer cup, start the chart drive motor of the recorder. Cover the cup with the metal top to prevent cooling and evaporation.

For a hot viscosity determination the test is entirely automatic. By arranging the conditions of the test, the viscosity characteristics of the starch are given by a continuous graph from which the following information can be read:

1. Time required for the initial viscosity rise and, by reading the thermometer in the paste, the temperature at this point.

2. Gelatinization range: the time and temperature

Kind of starch	*Sample,[a] grams moisture-free per liter*	*Counter-weight on dynamometer, g.-cm.*	*Approximate max. viscosity,[b] g.-cm. torque*
Corn, unmodified	4.5	225	50
	11.0	1800	1700
Corn, moderately thin boiling	6.5	225	35–150
	12.0	1800	1200–1600
Corn, thin boiling	7.5	225	35–80
	15.5	1800	1600–1800
Corn, very thin boiling	20.0	225	50–150
	35.0	1800	1200–1800
Wheat, unmodified	5.5	225	50
	11.0	1800	1700
Tapioca, unmodified	4.5	225	175
Tapioca, highest quality	7.0	1800	1500
Potato, unmodified (highest quality) approximates limits for tapioca			

[a] These concentrations are approximations of the extreme limits of representative starches of normal moisture content which can be tested in the Corn Industries viscometer. All intermediate concentrations can also be tested.

[b] Water bath at 92°C.

* This method is suggested by the Standards Committee as being the most suitable to date. It is *not*, however, a TAPPI Standard. Criticisms are earnestly requested and should be sent to R. G. Macdonald, Secretary, Technical Association of the Pulp and Paper Industry, 122 E. 42nd St., New York 17, N. Y.

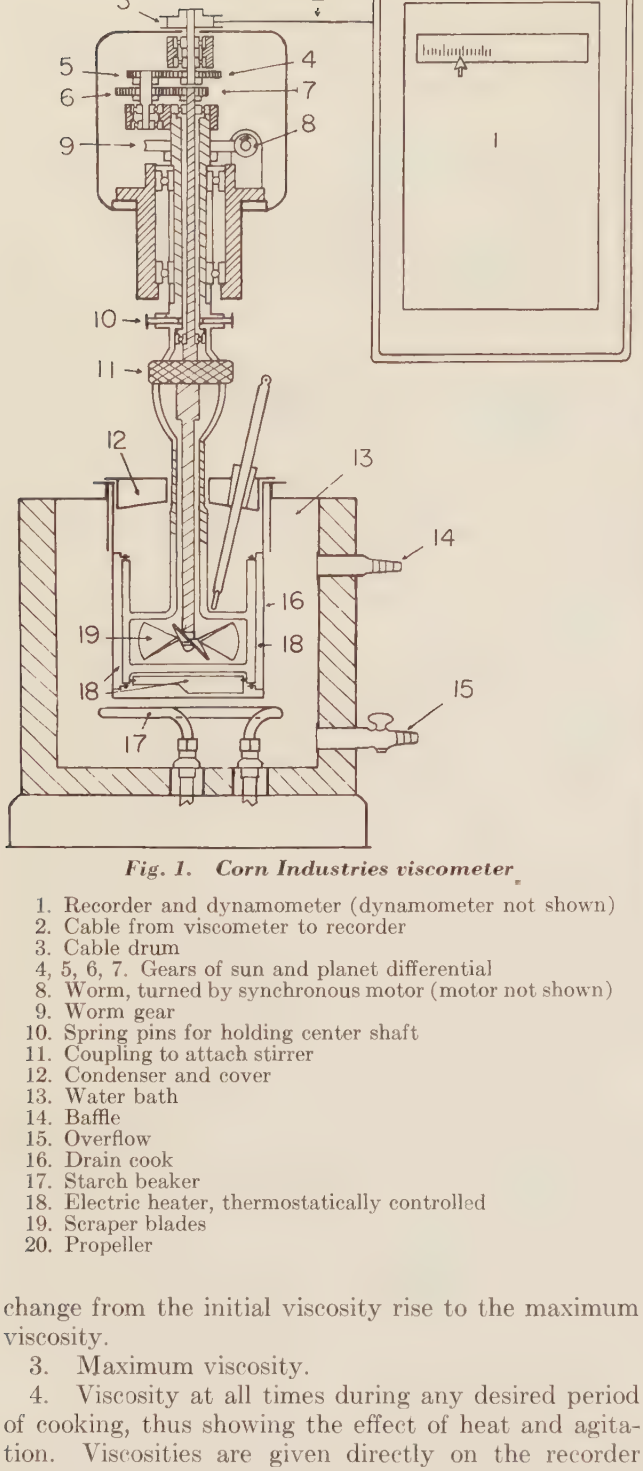


Fig. 1. Corn Industries viscometer

1. Recorder and dynamometer (dynamometer not shown)
2. Cable from viscometer to recorder
3. Cable drum
4, 5, 6, 7. Gears of sun and planet differential
8. Worm, turned by synchronous motor (motor not shown)
9. Worm gear
10. Spring pins for holding center shaft
11. Coupling to attach stirrer
12. Condenser and cover
13. Water bath
14. Baffle
15. Overflow
16. Drain cook
17. Starch beaker
18. Electric heater, thermostatically controlled
19. Scraper blades
20. Propeller

change from the initial viscosity rise to the maximum viscosity.

3. Maximum viscosity.

4. Viscosity at all times during any desired period of cooking, thus showing the effect of heat and agitation. Viscosities are given directly on the recorder chart in gram-centimeters of torque.

Note: For the effect of cooling on the viscosity of the paste, turn off the heater for the water bath after any desired period of cooking and circulate cold water through the water bath.

REPORT

Report the data desired, and by interpolation or extrapolation, if necessary, report the maximum viscosity of a 10% concentration of moisture-free starch in gram-centimeters at 92°C.

ADDITIONAL INFORMATION

The viscosity of a liquid system is its resistance to flow. It may be regarded as fluid or internal friction. While starch solutions are often spoken of as having viscosity, they do not have a true (Newtonian) vis cosity which a perfect fluid, such as water, has.

The so-called viscosity of a starch solution is th combined effect of a number of inherent propertie which cause it to deviate from Newtonian viscosity These effects occur from the residual granule particle or from new colloidal groupings that take place as result of cooking the starch. Many starches posses a varying degree of thixotropy, which results in th solution becoming thinner with agitation or when unde shear. In a starch paste, the observed viscosity de pends upon the rate of shearing to which it is subjecte in the viscometer; in a thixotropic paste, the greate the rate of shearing, the less the observed viscosit will be.

Viscosity data obtained for any starch are dependen upon the arbitrary selection of conditions of preparin the paste. Some types of starches reach a relativel stable viscosity, while with others the viscosity tend to decrease on continued heating, eventually reachin a value near that of water. The time required fo these changes to occur varies with different types c starches, and the same cycle of variation is eviden even when the same starch is prepared in differen concentrations. Also, some starches have a muc greater tendency than others to form organized struc tures or gels on cooling, which increases the viscosity Variables such as rate of heating, final maximum tem perature, and rate and kind of stirring cause differen observed viscosities. The method of preparing th starch suspension is thus very important and must b strictly observed if reproducible data are to be obtained even with the same type of viscometer.

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TAPPI DIVISIONS AND COMMITTEES

Reports of Activities

Acid Pulping Committee

The annual meeting of the Acid Pulping Committee was held on Monday, Feb. 16, 1953, at the Commodore Hotel, New York City.

The Eastern Section of the committee was represented by Thomas Gerace, O. E. Anderson, and J. D. Miller. The Lake States Section was represented by G. H. McGregor, chairman, and N. L. Malcove. The Pacific Coast was represented by E. H. Woodruff. In addition, the following people participated in the discussion: J. M. Piette, Union Bag & Paper Corp., Savannah, Ga.; S. E. Hazelquist, Weyerhaeuser Timber Co., Pulp Div., Longview, Wash.; H. S. Welsh, West Virginia Pulp & Paper Corp.; C. H. Anderson, Rayonier Inc., Shelton, Wash., and Jack Wilcox, Esco, Portland, Ore.

Those present were informed that the committee sponsorship of TAPPI Research Project No. 47 is continuing. In September, 1952, the committee requested $2000 and announcement of approval of this request was received on Nov. 1, 1952.

The title of this project is "Vapor-Liquid Equilibrium in the System NH_3–SO_2–H_2O." The work on this project is being done by TAPPI Research Fellow, Daniel T. Hayden, at the University of Washington, Professor J. L. McCarthy supervising. Project work so far completed is the development of equations for correlating equilibrium data in the system NH_3–SO_2–H_2O. Current work is under way on measuring of data in ranges not now listed in the literature.

The possibility of the committee sponsoring a research project on "Formic Acid, Presence of, Effect on and Elimination Therefrom in Sulphite Cooking" was discussed. Recommendation of those present was that this problem be submitted to the Fundamental Research Committee for consideration as a research project.

Another subject discussed was the possibility of the Acid Pulping Committee being responsible for certain testing methods and practices.

It was moved that the committee consider responsibility for only:

1. New methods, or revision of old methods, of testing as applied to liquors used in practice of acid pulping.
2. Testing of raw materials used for acid pulping. Decision of accepting the responsibility is pending upon poll of all members of the Acid Pulping Committee.

The committee also will be polled to determine if a subcommittee shall be appointed to handle testing methods only or if this shall be part of the function of the Acid Pulping Committee as a whole.

It is understood that methods and practices approved by the committee would be turned over to Mr. Macdonald for submitting to the Testing Division's review and approval.

The subject of "High Yield Acid Pulping" was brought up as one of particular interest to the industry. Those present expressed the thought that the Acid Pulping Committee should pursue the subject to find out about its present status through use of a TAPPI questionnaire, and as a possible result of the information assembled from the questionnaire project or projects would be sponsored for further investigation thereof.

For next year's Annual Meeting it was suggested that committee members be solicited for papers on "Plant Experiences When Acid Pulping with Cooking Acids Other Than Calcium Base Cooking Acid."

The Annual Acid Pulping Session was held on Feb. 17, 1953, in the Commodore Hotel, New York City. The following papers were presented:

1. "Converting to High Capacity Pulp Screens," by W. C. Stevens, A. T. Lynch, and P. W. Estates, International Paper Co., Chisholm, Me.
2. "Acid Pulping with Sodium Sulphate Liquor," by George A. Richter, Eastman Kodak Co., Rochester, N. Y.
3. "Miscellany on Ammonium Bisulphite," by Gordon A. Crowe, Spencer Chemical Co., Kansas City, Mo.
4. "Sulphur Usage and Distribution in Sulphite Pulping," by C. H. Anderson, Rayonier, Inc., Shelton, Wash.
5. "Spent Sulphite Liquor Studies, IV. Use of Spent Sulphite Liquor in Reconditioning Asphalt Road Surfaces," by Walter Sherman, George Bablick, Neal Rice, G. K. Dickerman, Groff Collett, and A. J. Wiley, Sulphite Pulp Mfg. League, Appleton, Wis. Paper presented by Mr. Sherman.
6. "Sulphite Digester Heater Tube Cleaning Survey," by J. M. Wilcox and W. R. Barber, Jr., Electric Steel Foundry Co., Portland, Ore. Paper presented by Mr. Wilcox.
7. "Development of 65% Yield Sulphite for Newsprint Furnish," by Frank P. Silver and L. R. Beath, Price Brothers and Co., Ltd., Riverbend, Que. Paper presented by Mr. Beath.
8. "The Determination of Total Nonaqueous Constituents in Pulp Mill Liquors, II. Application to All Types of Residual Pulping Liquors," by J. H. Phillips and M. M. Rubright, Babcock and Wilcox Co., Alliance, Ohio.

E. H. WOODRUFF, *Chairman*

Deinking Committee

The Deinking Committee met at The Commodore Hotel, New York, N. Y., Feb. 16, 1953. The members of the committee and guests present were:

R. H. Doughty, Fitchburg Paper Co.
Charles R. Bragdon, Consulting Chemical Engineer
R. M. Elias, Bergstrom Paper Co.
P. B. Hansen, Bergstrom Paper Co.
William R. Dial, Columbia-Southern Chemical Corp.
M. P. Boland, Columbia-Southern Chemical Corp.
John T. Moynihan, National Bureau of Standards
Martin M. Scher, Consultant
John M. Clouse, Oxford-Miami Paper Co.
Rolfe C. Bradbury, Mead Corp.
C. A. Rietz, Interchemical Ptg. Ink Div.
A. M. Altieri, Tileston & Hollingsworth Co.
J. W. Wendell, Jr., Tileston & Hollingsworth Co.
Doyle Boggess, Beveridge Paper Co.
Louis J. Scheid, Watervliet Paper Co.
F. C. Goodwill, St. Regis Paper Co.
A. J. Palladino, NCSI
H. R. Amberg, NCSI, Corvallis, Ore.
F. L. Fennell, du Pont Electrochemical Dept.
Ronald W. Hynes, Newton Falls Paper Co.
W. A. Kirkpatrick, Allied Paper Mills
Merle R. Wilkins, Kalamazoo Paper Co.
J. J. Forsythe, International Paper Co.
A. W. Infanger, The Cowles Co.

The meeting was called to order by Chairman Forsythe. The first order of business was the election of a permanent chairman and a permanent secretary for the coming year. It was moved, seconded, and passed by voice vote that J. J. Forsythe and A. W. Infanger be re-elected to serve as chairman and secretary, respectively, of the committee.

Reports were received on the progress of the various sections of the monograph on deinking. The three unassigned sections were discussed and Mr. Altieri agreed to start work on Section 2—"Properties of Reclaimed and Deinked Waste Paper," and Mr. Doughty agreed to begin work on Section 7—

"Theory of Deinking." Section 4 will be referred to members of the Waste Paper Dealers Association.

Mr. Altieri suggested that a questionnaire be circulated to users of deinked stock on which they would write their general ideas of the properties of deinked stock, with numerical data if available. It was decided to follow this procedure in obtaining data for Section 2 of the monograph.

Mr. Doughty will compile an outline and data from Section 7 on the "Theory of Deinking," and will circulate it to other authorities in the field of deinking for discussion and the subsequent completion of the section.

Section 9—"Screening and Washing": Mr. Bradbury indicated that considerable progress has been made. He has received data and material from Mr. Hynes and others. Mr. Bradbury recommended that submitted data be considered as a group contribution, rather than that of any one individual.

Section 10—"Alkali and Heat Recovery": Mr. Goodwill is well along on this section. He mentioned that, to his knowledge, one other company is now reclaiming heat and alkali, and he will try to obtain data from this mill.

Section 12—"Waste Effluent Disposal": Mr. Palladino has summarized considerable data, and is compiling all available information from the literature on the subject.

Several subjects, such as methods of sampling, mill testing, and various quality control methods were discussed. Mr. Bradbury described his method of testing for moisture. He finds about 12% moisture as a good average in Chillicothe. The foreman of the unloading crew makes the first inspection of incoming stock and reports his findings to the superintendent of the deinking plant. The stock is then unloaded and warehoused. Two men per tour examine the stock when loading the warehouse conveyor, and reasonable quantities of rejects are charged back. Unusual quantities cause the entire carload to be rejected.

Mr. Hynes of the Newton Falls Paper Co. uses a full-time inspector to check incoming material. Rejects are sorted and stock is rebaled. Mr. Hynes asked for various inspection methods.

Mr. Kirkpatrick of the Allied Paper Mills uses basically the same method described by Mr. Bradbury of the Mead Corp.

Mr. Bradbury of the Mead Corp. said that his mill maintained a display of current contaminating materials, and also had a system for training the sorting staff.

Mr. Doughty of the Fitchburg Paper Co. uses the same method as Mead, but does not have quite as thorough inspection.

Mr. Forsythe of the International Paper Co. stated that incoming stock is inspected on the unloading platform to catch all possible rejects. They employ girls to do the sorting. Most of the trouble is from ledger stock. Much wet strength is unidentifiable.

Mr. Altieri started a discussion on yield and shrinkage of waste furnishes. Data on this phase of the deinking process could be included in the monograph; probably in Section 12, but the subject must of necessity be touched on in many of the other sections. How is yield or shrinkage to be defined and tested in a standard procedure? Discussion of terminology and method of calculating yield followed.

A questionnaire to deinking mills was suggested to determine methods used to find yield and shrinkage. The results of this effort could possibly be developed into a new separate section.

Mr. Hynes of the Newton Falls Paper Co. asked if anyone had inquired (from wastepaper dealers) about the cost of correctly sorting and baling selected waste materials. It was decided to present the question at the Waste Paper Meeting of this convention.

There was a short discussion of disastrous effects of poly-content printing inks, and poly-wax coated papers. Representatives of the ink manufacturers who were present stated that poly-content inks, for large-scale use, were some dis tance in the future.

Tentative plans were made for a meeting of the Deinkin Committee and monograph contributors at Niagara Fall during the week of May 18. The most favorable dates men tioned were May 20 and 21.

A. W. Infanger, *Secretary*

Mechanical Pulping Committee

The Mechanical Pulping Committee met at the Commo dore Hotel, New York, N. Y., on Feb. 16, 1953. The mem bers of the committee present were: F. W. O'Neil, Earl H Johnson, T. F. LaHaise, W. E. DeMontmorency, R. L. Leaf Jr., and J. H. Perry. Members who were absent were T. E Kloss, R. A. Magruder, Karl Pingrey, Axel Hytinnen, an J. K. Kirkpatrick.

Fred W. O'Neil opened the meeting with a discussion of th "Groundwood Committee Survey Data Sheet," which ha been circulated to the committee members during the pas year.

It was decided that the report submitted by Mr. Drum mond concerning the mechanical details of the groundwoo mills were excellent and contained a wealth of information In view of this it would not be necessary to solicit further o more up-to-date information respecting this phase. How ever, the rapidly changing picture of everyday operating con ditions in mills led the committee to seriously consider th possibility of revising the form of the data sheet so that i could more nearly cover the current mill practices. A lette explaining the new data sheet and its purpose will accom pany the sheet to be sent to the mills. It will be noted tha the data sought for on the revised data sheets are curren up-to-the-minute information and was prompted by the fac that such information does not exist in a tabulated, easy t decipher form. The committee feels that this information wil be of value to the members of TAPPI and to the industry a a whole.

Professor O'Neil read a letter from T. E. Kloss, in whic he suggested the following changes in report 336. "If pag 16 had been inserted as page 1, and had placed total tonnag before each type of pulp, left the freeness as is, and added th number of units in place of last column, the reader would im mediately understand other details. In other words, h would thus identify the mill that he wanted to follow righ through the four reports. The reader should not have to g through the process of multiplying figures to get at produc tion capacity and later discover that it was not this mill afte all. What he wants is the size of the mill first and what it i doing, with a certain quality of pulp." No action was take at this time on Mr. Kloss's suggestion, however it was con sidered a good thought and will be given serious consider ation at the first opportunity.

Mr. De Montmorency proposed that more frequent meet ings of the mechanical pulping committee be held. It wa readily agreed that additional meetings were in order and th chairman set the next one tentatively for some time in Jun when it is expected that the data sheets will all have been re turned to committee.

It was proposed also that John H. White, past-chairma of the CPPA Groundwood Committee be invited to join thi group. The secretary was asked to contact Mr. White (Mr. White has informed the writer by phone that he wi be happy to serve.)

The meeting closed with the resolution that the Mechanica Pulping Committee would exert every effort to be of servic to TAPPI and the pulp and paper industry.

J. H. Perry, *Chairman*

Pulp Purification Committee

The Pulp Purification Committee met at the Commodor

otel, New York, N. Y., Feb. 16, 1953. The members e ent were:

. Woodside, Mathieson Chemical Co.
. Casciani, Niagara Alkali Co.
. Taylor, Columbia-Southern Chemical Corp.
. Nethercut, Scott Paper Co.
. L. Jones, Hercules Powder Co.
. H. Rapson, University of Toronto
. Husband, College of Forestry, State University of New York
Noble, Improved Machinery Corp.
. Harrison, Riegel Paper Corp.
. P. Edwardes, Consultant
. O. Elderkin, Bowaters Southern Paper Corp.
. Kraft, Marathon Corp. of Canada
. Perkins, Improved Machinery Corp.
. Burchfield, Wyandotte Chemical Corp.
. McEwen, Buffalo Electro-Chemical Corp.
. Schuber, Solvay Process Co.
. S. Hatch, Hudson Pulp & Paper Co.

. reorganizing the committee, W. H. Rapson, of the Uni- ity of Toronto, was elected chairman and R. L. McEwen elected secretary.

The primary subject matter discussed related to the proper tion of the committee, and to the subject matter to be onsored. It was generally agreed that the committee ld concern itself mainly with proper pulp purification blems, sponsoring new exploratory research with TAPPI ncial backing, rather than collecting and editing old or own data.

Several subjects were suggested and discussed, among e were:

1. Proper role of the various bleaching agents in purification and bleaching.
2. Importance and role of viscosity in paper quality.
3. Improvement in bleachability tests.

At a short meeting of committee members with the chair- an, held on February 19, it was agreed that the project for is year would be organization of a one-day symposium on lp bleaching and purification for the 1954 TAPPI meeting. his will take the form of four papers in the morning on lected topics by selected speakers, preferably from pulp anufacturing companies, and a panel discussion on the prob- ms of pulp bleaching and purification in the afternoon.

Since the TAPPI Monograph on Pulp Bleaching is in press d should issue soon, this should serve as a basis for prepa- tion of such a symposium.

J. d'A. Clark suggested on Feb. 16, 1953, that the com- ittee may want to appoint members to a subcommittee on sting. No action was taken, however.

R. L. McEwen, *Secretary*

lastics Committee

A meeting of the Plastics Committee was held at 3:30 m. at the Hotel Commodore, New York, N. Y., on Feb. , 1953. About 35 members attended the meeting which llowed meetings of the various subcommittees.

HAIRMAN'S REPORT

Mr. E. C. Jahn gave the chairman's annual report which as as previously circulated to all committee members.

BCOMMITTEE CHAIRMEN'S REPORTS

1. *Resin Analysis:* Mr. Church had to leave after the bcommittee meeting and Mr. Jahn stated that this com- ittee had been inactive for some years and that the chair- an wished to resign. It was felt by some that the work uld be handled by other committees. Mr. Nazzaro gave s own committee's view that the identification of coating d other resins was an important matter. It was resolved at efforts would be made to find a new group that might be terested in such problems so that it could work with the nverting subcommittee and other subcommittees.

2. *Resin Advisory:* Mr. Mark reported on subjects suggested for papers at the Fall meeting. For the session dealing with fundamental questions and new resins, sponsored by the Resins Advisory Subcommittee, the following topics were suggested:

Fundamental Papers: "Resinography," by T. G. Rochow, American Cyanamid Co.; "Block and Graft Copolymers," by R. B. Mesrobian, Polytechnic Institute
Papers Concerning Special Resins: "Epoxy Resins," by F. Bradley, Shell Development; "Water Soluble and Water Dispersible Polyamides"; "Progress in the Polyester Field," F. R. Eirich, Polytechnic Institute; "Modified Polymers Containing Fluorine," by H. Kaufman, M. W. Kellogg Co.; "Polyethyleneimine," by H. Mark, Polytechnic Institute

3. *Fabrication and Structural Products:* R. J. Seidl of the Forest Products Laboratory, Madison, Wis., had been elected as the new chairman to take the place of Mr. Straka who has resigned. Mr. Seidl had no report to make at this time. Mr. Jahn suggested that this group review the several projects in which it had previously been interested.

4. *Plastics in Paper Converting:* Mr. Nazzaro reported on the papers presented at the last Fall meeting. No definite news had been received from TAPPI regarding the proposed permeability project. Two new research topics were proposed by his subcommittee. These were (1) the comparison between static and cyclic conditions for testing barrier materials, and (2) methods for the identification of coating resins. It was proposed to send a questionnaire to committee members regarding plastic and resin problems.

Cellulosic Materials: Forrest Simmonds reported that his subcommittee wished to sponsor a program at the Annual TAPPI Meeting on dissolving pulps including a panel discussion. He reported that the subcommittee had now formally approached TAPPI to be made into a full TAPPI Committee on Chemical Pulps.

Fall Meeting: The chairman reported on tentative plans for the Fall plastics conference. The general pattern of one day on fundamental papers and one day on practical papers would be maintained for the 1953 meeting. Mr. Nazzaro thought that the papers should expand away from coating topics into laminating and sizing problems and suggested that the 212 members who attended the 1952 meeting be canvassed as to their views on topics for papers or discussion. Mr. Jahn said the committee was fortunate in having received cordial invitations to hold the meetings at the Polymer Institute, Polytechnic Institute of Brooklyn, Brooklyn, N. Y. (H. Mark), and at The Institute of Paper Chemistry, Appleton, Wis. (T. A. Howells). It was felt that every few years the meeting should be held away from Syracuse for geographical reasons. The question of location and program of the Fall meeting would be arranged by a program committee consisting of the chairman and secretary of the Plastics Committee and the chairmen of the various subcommittees.

Election of Chairman: E. C. Jahn announced that he would not be available for nomination as chairman this year. He pointed out that he has been chairman since the inception of the committee in 1944 and believed that it was sound policy to change chairmanship for the best interests of the committee and TAPPI. Mr. Jahn then asked Forrest Simmonds to take the chair. Mr. Simmonds called for nominations.

R. T. Nazzaro of the Westfield River Paper Co., Russell, Mass., was nominated and unanimously elected chairman.

J. Pullman, American Cyanamid Co., Stamford, Conn., was elected chairman of the Paper Converting Subcommittee to succeed Mr. Nazzaro.

The meeting adjourned at 4:50 p.m.

Members of the Plastics Committee are:

Ralph T. Nazzaro, Chairman, The Westfield River Paper Co., Russell, Mass.
V. T. Stannett, Secretary, State University of New York, College of Forestry, Syracuse 10, N. Y.

Subcommittee on Fabrication and Structural Products:

R. J. Seidl, Chairman, U. S. Forest Products Laboratory, Madison 5, Wis.
J. R. Arthur, Port Huron Sulphite Pulp & Paper Co., Port Huron, Mich.
R. L. Griffeth, Director of Technical Dept., Mica Insulator Co., Schenectady, N. Y.
W. S. Grimes, Consolidated Water & Power Co., Wisconsin Rapids, Wis.
Lois Hans, U. S. Army Research & Development Quartermaster Corps, 2800 E. 20th St., Philadelphia, Pa.
L. V. Larsen, Plastics Laboratory, General Electric Co., Coshocton, Ohio
John C. Pitzer, Chemical Engineer, The Formica Insulation Co., Cincinnati 32, Ohio
E. L. Rastatter, Plastics Div., Hammermill Paper Co., Erie, Pa.
J. H. Robertson, Research Dept., Howard Smith Paper Mills, Ltd., Cornwall, Ont.
Norman A. Skow, Synthane Corp., Oaks, Pa.
H. A. Spencer, Knowlton Bros., Watertown, N. Y.
C. J. Straka, Laboratory Supervisor, Micarta Div., Westinghouse Electric Corp., Trafford, Pa.
G. E. Vybiral, Engineering Dept., Panelyte Div., St. Regis, Paper Co., Deferiet, N. Y.

Subcommittee on Plastics in Paper Converting:

J. C. Pullman, Chairman, Technical Service and Development Div., American Cyanamid Co., Stamford, Conn.
J. A. Aid, Research Dept., Robert Gair Co., Inc., Uncasville, Conn.
Charles Clark, B. F. Goodrich Chemical Co., 324 Rose Bldg., Cleveland 15, Ohio
Norman L. Greenman, Development Engineer, Rogers Corp., Goodyear, Conn.
Walter L. Hardy, General Manager, Leedpak, Inc., 294 Fifth Ave., New York 1, N. Y.
T. A. Howells, Institute of Paper Chemistry, Appleton, Wis.
Robert H. Mosher, Munising Paper Co., Chicago, Ill.
E. G. Paxton, Jr., Dilts Machine Works, Fulton, N. Y.
Lloyd H. Silvernail, Dow Chemical Co., Midland, Mich.
Robert C. Sturken, Frank W. Egan & Co., Bound Brook, N. J.
J. J. Uber, Plastic Coating Corp., 38 Winter St., Holyoke, Mass.
Paul H. Yoder, Eastern Manager, Pyroxylin Products, Inc., Russell Rd., Paoli, Pa.

Subcommittee on Resin Analysis:

S. Earll Church, Chairman, State University of New York, College of Forestry, Syracuse 10, N. Y.
C. H. Alexander, B. F. Goodrich Chemical Co., 324 Rose Bldg., Cleveland 15, Ohio
R. W. Reiter, National Starch Products, Inc., 270 Madison Ave., New York 16, N. Y.
W. Allen Schenck, Chemist, Riegel Paper Corp., Milford, N. J.
R. W. Stafford, American Cyanamid Co., Stamford, Conn.
Quintin C. Weaver, Scott Paper Co., Chester, Pa.

Subcommittee on Cellulose Materials:

Forrest A. Simmonds, Chairman, U. S. Forest Products Laboratory, Madison 5, Wis.
R. S. Apple, Research Supervisor, E. I. du Pont de Nemours & Co., Burnside Laboratory, P.O. Box 152, Penns Grove, N. J.
Roe C. Blume, Research Supervisor, E. I. du Pont de Nemours & Co., Inc., Waynesboro, Va.
G. A. Day, Chief Chemist, Brown Co., Berlin, N. H.
Merle A. Heath, Associate Director of Development, Chemical Pulp Div., Buckeye Cotton Oil Co., Memphis 8, Tenn.
C. V. Holmberg, State University of New York, College of Forestry, Syracuse 10, N. Y.
A. T. Maasberg, Director of Research, Cellulose Products Div., Dow Chemical Co., Midland, Mich.
William E. Roseveare, Research Associate, E. I. du Pont de Nemours & Co., Richmond, Va.
Milton O. Schur, Technical Director, Ecusta Paper Corp., Pisgah Forest, N. C.
Peter Van Wyck, Assistant to Director of Research, Hercules Powder Co., Wilmington, Del.

Resins Advisory Subcommittee:

Herman F. Mark, Chairman, Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn 2, N. Y.
C. H. Alexander, B. F. Goodrich Chemical Co., 324 Rose Bldg., Cleveland 15, Ohio
M. H. Bigelow, Technical Director, Plaskon Div., Libbey-Owens-Ford Glass Co., 2112 Sylvan Ave., Toledo, Ohio
Francis G. Felske, Resinous Products & Chemical Co., Washington Square, Philadelphia 5, Pa.
J. W. Ferguson, Assistant Manager of Resins Div., Durez Plastics and Chemicals, Inc., North Tonawanda, N. Y.
R. P. Goodall, Rohm & Haas Co., Philadelphia 5, Pa.
H. Kline, Phenolic Plastics Div., Reichhold Chemicals, Inc. Detroit 20, Mich.
Richard Lindenfelser, American Cyanamid Co., Stamford Conn.
P. F. Neumann, Manager, Technical Service, Paper Makers Chemical Dept., Hercules Powder Co., Wilmington, Del.
L. P. Saxer, Rohm & Haas Co., Philadelphia 5, Pa.
G. R. Sido, Chemist, Research Dept., Plastics Div., Monsanto Chemical Co., Springfield, 2, Mass.
George H. Tomlinson, II, Research Director, Howard Smith Paper Mills, Ltd., Cornwall, Ont.
Richard Upright, Dow Chemical Co., Midland, Mich.
H. F. Wakefield, Research Chemist, Bakelite Corp., 30 E 42nd St., New York 17, N. Y.

V. T. Stannett, *Secretary*

Plastics Committee (1952)

The Plastics Committee was organized in 1944 and plans were made to hold its first session at the February, 1945 TAPPI Meeting. Due to the war the Annual Meeting was canceled. However, the First Paper-Plastics Conference sponsored by the Plastics Committee was held May 15–16, 1945, at the New York State College of Forestry, Syracuse, N. Y. About 75 persons attended.

On Nov. 5–6, 1952, the eighth successful Paper-Plastics Conference was held at the College of Forestry, Syracuse, N. Y., with an attendance of 212 persons. These conferences have become regular annual affairs and provide a forum for discussing new resin developments and techniques of application of interest to paper manufacturers, paper converters, laminators, and others who combine paper with resins or who produce pulps for the cellulosic plastics.

The committee has also carried out and is currently studying a number of projects. There are 10 authorized Plastics Committee projects listed in the 1952 *TAPPI Yearbook*.

Organization

The Plastics Committee has grown so that present membership numbers 56. Due to the large amount of correspondence and other work, the chairman with the advice of Mr. Macdonald, Secretary of TAPPI, has appointed a committee secretary. He is V. T. Stannett, Assistant Professor of Polymer Chemistry, State University of New York College of Forestry, Syracuse 10, N. Y.

The committee has at present five subcommittees, namely:

Subcommittee on Fabrication and Structural Products
Subcommittee on Plastics in Paper Converting
Subcommittee on Resin Analysis
Subcommittee on Cellulosic Materials
Resins Advisory Subcommittee

February, 1952, Meeting

1. Business Meetings: Regular annual business meetings were held by the various subcommittees at 2.00 p.m. and of the Plastics Committee as a whole at 4.00 p.m. on Feb. 18, 1952, at the TAPPI Convention in New York. The following technical subjects were discussed:

(a) Need for standardized paper tests for use by the paper maker when making saturating grades.
(b) Need for an interpretive review of the literature on pulp for the viscose process.
(c) Need for keeping Mr. Shaw's "Bibliography on Resin Analysis Literature" up to date.
(d) Coordination of analysis standards with ASTM and Society of Plastics Industry.
(e) Committee should serve as a clearing house for resin analysis methods, especially where the need of standardization is evident.
(f) Sponsorship by TAPPI of research on permeability.
(g) The government barrier materials and specifications.

Other business discussed included:

(a) Establishment of the Subcommittee on Cellulosic Materials for Plastics as a separate committee. Decision delayed.
(b) The Fall meeting.

2. Plastics Session: The committee sponsored a technical session for the morning of Feb. 19, 1952. Five papers were presented. Attendance varied from 100 to 150.

Fall Meeting at Syracuse

The Eighth Paper-Plastics Conference was held Nov. 5–6, 1952, at the State University of New York College of Forestry, Syracuse, N. Y. The program for the first day dealt with new developments in plastics and their relation to paper and was arranged by Herman Mark. The second day was devoted to the application of plastics to paper. This program was developed by R. T. Nazzaro. The new paper coating laboratories of the Dilts Machine Co., Fulton, N. Y., was visited by many who attended the conference.

A panel discussion of paper-plastic problems was held during the afternoon of the final day. The conference was a very successful one with 212 persons attending, 194 from out of city.

Problems

A critical review of the ten authorized Plastics Committee projects as well as the subjects reviewed at the last business meeting (and listed above) needs to be made. Activation of some of these should be undertaken.

EDWIN C. JAHN, *Chairman*

Wet Strength Committee

The Wet Strength Committee met at the Commodore Hotel, New York, N. Y. on Feb. 16, 1953. The members of the committee and guests present were:

K. W. Britt, Chairman, Scott Paper Corp.
J. P. Weidner, Container Corp. of America
J. E. Donohue, Hercules Powder Co.
R. G. Hart, Borden Co., Chemical Div.
J. S. Moore, Union Bag & Paper Co.
H. L. Winslow, American Reinforced Paper Co.
W. M. Roeske, Dow Chemical Co.
H. J. Kurjan, C. H. Dexter & Sons, Inc.
S. T. Moore, American Cyanamid Co.
L. E. Kelley, Rohm & Haas Co.
C. S. Maxwell, American Cyanamid Co.
E. J. Kane, Thomas J. Lipton, Inc.
R. Carter, Reichhold Chemical Co.
J. J. Levenson, Jr., Reichhold Chemical Co.
T. B. Brown, Reichhold Chemical Co.
H. R. Titus, Brown Co.

As the first item of business, the following changes in the personnel of the Wet Strength Committee were formally announced: Geo. Niles, formerly of Monsanto Chemical Co., has resigned. I. J. Gruntfest, of Rohm & Haas, has resigned and L. E. Kelley of the same company has taken his place. I. Y. Charbonnier, of Union Bag & Paper Corp., has resigned, and Glenn Kimble, also of Union, has taken his place and J. E. Donohue, of the Hercules Powder Co., was accepted as a new member.

The present membership of the committee is as follows:

K. W. Britt, Scott Paper Co., Chester, Pa., Chairman
C. S. Maxwell, American Cyanamid Co., Stamford, Conn., Secretary
J. B. Davidson, Plaskon Div., Libbey-Owens-Ford Glass Co., Toledo, Ohio
J. F. Donohue, Hercules Powder Co., Wilmington, Del.
L. E. Kelley, Rohm & Haas Co., Philadelphia, Pa.
J. P. Weidner, Container Corp. of America, Manayunk, Pa.

The members of the Advisory Subcommittee are:

G. A. Day, Brown Co., Berlin, N. H.
R. G. Hart, Borden Co., Chemical Div., Bainbridge, N. Y.
Glenn Kimble, Union Bag & Paper Corp., Savannah, Ga.

In reference to the part the Wet Strength Committee would take in next year's program, it was generally agreed that no attempt would be made to prepare material for a Fall meeting but that there definitely should be a wet strength session at the 1954 Annual TAPPI Meeting.

The TAPPI wet tensile strength method (T 456 m-49) has been listed as a tentative standard for several years and its advance to an official standard has been suggested. Inasmuch as ASTM expects to study its present method (which differs rather markedly from T 456 m-49) with a view to revision, it was agreed that T 456 m-49 should not be advanced to official status until ASTM has had a chance to study the method. It was the consensus of the group that, if possible, ASTM and TAPPI should be in agreement in this test. To this end your secretary has been authorized to write to the ASTM Paper Testing Subcommittee, through Roger Griffin, chairman of the TAPPI Standard Committee.

Our major project for this year, the "Wet Strength Monograph" is slowly taking shape. The status of the various sections is summarized as follows:

Section	*Title*	*Author*	*Status, 1st draft*
I	Introduction	K. W. Britt	Finished
II	Raw Materials	C. S. Maxwell	Finished
III	Production Operations	J. B. Davidson	?
IV	Chemistry—Theory	I. J. Gruntfest	Almost completed
V	Process Control	J. Weidner	Finished
VI	Testing Methods	C. S. Maxwell	In progress
VII	Market Evaluation	I. J. Gruntfest L. Kelley	? ?
VIII	Index	.....	.....

It was decided that instead of including a rather complex bibliography at the end of the monograph, each section would list references referred to in the text, and the final section of the monograph would be an index.

C. S. MAXWELL, *Secretary*

Container Evaluation and Development Committee

This meeting of the Container Evaluation and Development Committee was called to order at 2 p.m., Tuesday, February 17, in Parlor G, of the Commodore Hotel in New York City.

The meeting was opened by Chairman C. H. Krebs and since this was the first official meeting of the committee under its new name, new scope, and new alignment, a short history was given of the committee, the reason for the change of name and scope. This history was originally published in the February, 1953, issue of *Tappi*.

The reports of subcommittees were given as follows:

Bursting Strength of Heavy Board by Ed Dahill, Chairman
Nomenclature, by Frank Wilcox, Chairman
Method of Measurement, by Charles Zusi, Chairman
Method of Testing of Manufacturers Joints, by Horace Scordas, Chairman
Report on Coordination of Standards on which ASTM-TAPPI have similar procedures, but now with different techniques, by Ed Petze, Chairman
Report of the Committee on ASTM Standards Prepared for Adoption by TAPPI, by Darrell Martin, Chairman

After discussion of the Bursting Strength of Heavy Boards, a tentative standard was presented for consideration by the committee. It is being returned to the chairman for corrections and rewriting because of certain minor discrepancies, agreed on. The rewritten tentative standard will be sent out to the committee for additional comments as quickly as it can be rewritten.

Nomenclature: The second of a series of 25 words was submitted for discussion. Of this number, seven were acceptable as written. On four words, it was decided to take the ASTM definition. Two words were omitted as not being pertinent to the uses of the committee. Several words were

grouped in the subdivisions of one general term. This series of definitions will be rewritten following the recommendations of the committee.

The Method of Measurement was reported to be in progress.

The Method of Testing of Manufacturers Joints was reported in progress.

A report on coordination of standards on which ASTM-TAPPI have similar standards but different techniques is reported in progress. This is a particularly complicated job because it means getting an agreement through the ASTM-TAPPI Coordinating Committee between ASTM and TAPPI, taking the better parts of the existing standards from each organization to complete a standard acceptable to both groups.

The report of the Committee on ASTM Standards prepared for adoption by TAPPI: It was decided to send these out by mail, as each of these standards must be checked carefully by each member of the committee.

Several changes were made in the wording of the projects:

No. 235—Compression Resistance of Container Boards: It was decided to use the ASTM Committee D-6 Tentative Standard.
No. 268—Scuffing and Peeling Resistance of Container Boards: Use ASTM D-6 Tentative Standard.
No. 269—Performance of Interior Packing: Use ASTM Committee D-10 Tentative Standards.
No. 363—Revision of the Bursting Strength Test (T 403-47): Changed to read as follows: "Revision of the Bursting Strength Test for Paperboard."
No. 364—Vibration Test for Shipping Containers: A round robin of testing is to be developed for this project.
No. 365—Strip Score Test: This method is to be omitted.
No. 403—Sampling Procedures for Container Testing: To be eliminated and in its place the project is to read, "Sampling Procedures."
No. 406—Methods of Testing Strapping and Other Reinforcing: To be reworded "Methods of Testing Closures."
No. 407—Definition of Terms Relating to Containers: To be changed to read: "Nomenclature Relating to Container Evaluation and Development."

New projects to be added to this list are as follows:

1. Correlation Between Atmospheric Conditions and Strength of Fiberboard.
2. Method of Measuring Compound Curves.
3. Conbur Compound Curve Test for Corrugated Containers.

In a review of the Advisory Board; a replacement was recommended for T. A. Carlson, who passed away during the year. Charles Root was selected.

For the year 1953 and 1954, Charles Krebs was elected chairman, C. S. Macnair was elected secretary. Both men have served two years.

Container Testing Subcommittee: This subcommittee was formed and the following people were appointed to the committee.

W. J. Balster
C. J. Zusi
R. S. Kurtenacker
E. R. Stivers
A. V. Grundy, Chairman

Three proposed tentative standards have been distributed to the committee for vote:

Water Resistance of Containers by The Spray Method Drop Test for Cylindrical Shipping Containers
Drop Test for Bags

C. S. Macnair, *Secretary*

Corrugated Containers Committee

The Steering Subcommittee of the Corrugated Containers Committee met in Room B of the Commodore Hotel in New York, Feb. 16, 1953. The following members were present:

W. K. Metcalfe, J. O. Ross Engineering Corp., New York City
K. W. Max, Robert Gair Co., Inc., New London, Conn.
J. J. Koenig, Gaylord Container Corp., St. Louis, Mo.
J. P. Greiveldinger, Robert Gair Co., Inc., New London, Conn.
R. W. Buttery, Bathurst Power & Paper, Kraft Containers Ltd., Hamilton, Ont.
F. D. Long, Container Corp. of America, Chicago
J. C. Waddell, American Box Board Co., Grand Rapids, Mich.
L. K. Burnett, Ohio Boxboard Co., Rittman, Ohio
H. T. Scordas, Union Bag & Paper Corp., Savannah, Ga.
D. P. McNelly, Fort Wayne Corrugated Paper Co., Rochester, N. Y.
B. Mendlin, Cornell Paperboard Products, Milwaukee, Wis.
M. F. Knack, River Raisin Paper Co., Monroe, Mich.
John Fuko, River Raisin Paper Co., Monroe, Mich.
W. W. Marteny, National Container Corp., Tomahawk, Wis.

The meeting was called to order by F. D. Long who turned the meeting over to the new chairman, Burt Mendlin, and mentioned that the secretary for the coming year would be W. W. Marteny.

L. K. Burnett expressed his appreciation, in behalf of the Executive Committee, for the splendid work that F. D. Long had done during the past year.

A. Old Business

1. Program for the 1953 Annual Meeting. Plans for the meeting were discussed:

(a) "Corrugated Liner Web Printing," with Don McNelly as moderator. There will be seven speakers on Machinery, Inks and Coatings, and Operation: Mr. Stemple, L. O. Carlisle, J. Gessner, Mr. Baker, K. H. Holm, L. K. Burnett, and J. W. Viner.
(b) "Flute Design and Chrome Plating," J. J. Koenig will act as moderator. There are three papers to be delivered: two by A. Werner and one by M. P. Boggio. L. M. Walker to be sitting on the panel.
(c) "Corrugated Waste Control," K. W. Max, moderator. Three papers will be presented by J. P. Forgac, L. J. Bloom, Mr. Roberts, and R. W. Buttery. The question of getting the definitions of waste accepted by TAPPI was discussed. Several possibilities for the publication of these were considered. Among them are the use of the TAPPI data sheets and the Routine Control Methods.
(d) "Glued Lap Boxes," W. W. Marteny will act as moderator. He has arranged for four speakers, namely: R. A. Thompson, F. R. Di Franco, C. I. Jacobs, and A. W. Hoffman.

2. Summary of Combiner Questionnaire: It was mentioned that the summary has several inaccuracies which must be corrected.

The meeting of the subcommittee (H. T. Scordas, J. J. Koenig, B. Mendlin, W. R. Tobin or J. C. Waddell, and Mr. Long) was scheduled for Wednesday, April 22, 1953, in F. D. Long's office at 9:00 a.m. Anyone interested in attending this is welcome.

Mr. Scordas now has the questionnaire and all the material. He will ship all the material to Chicago so that it will be there in time for the meeting.

The completed summary must be distributed to the participating members at least 30 days prior to publication.

B. New Business

1. Each committee member was urged to name an alternate. This alternate can be either from his own company or another company. He may serve as vice-chairman of the subcommittee. In any event, each subcommittee chairman should appoint a vice-chairman. Members of the subcommittees do not have to be members of TAPPI.

2. John Fuko will act as Mr. Knack's alternate.

3. J. P. Greiveldinger will assume chairmanship of the Stitching and Taping Subcommittee.

4. All subcommittee chairmen should bring their committees up to date in appointing new members where necessary. In all subcommittee work, the following order will be followed:

The subcommittees submit questionnaire to the secretary.
The secretary distributes it to the steering committee.
The steering committee returns it to the secretary with their comments.

The secretary returns it to the subcommittee chairman with all comments.

5. A Fall corrugating conference for 1953 was discussed. G. W. E. Nicholson suggested that the next corrugating conference be held on the East Coast. He has written a letter to F. D. Long indicating his suggestion as shown by the following excerpts:

"Your thinking is very much along the lines of my own, and that is that we should try to create the same kind of interest in the work by the committee in the eastern and southern part of the states, as you have done in the middle west. Because of the fact that the industry is so much older in the east, my thought was that the next should be meetings held in the eastern states.

"I talked the other day to Bill Eustis of Robert Gair Co., asking him to talk to other men in the corrugated box end to see if there would not be somebody in their organization who would take the leadership to arrange for a meeting during the month of April at some location in the east where at least two or three corrugated box plants would be located so that the same combination could be brought about as in the middle west, meeting with discussions together with visits to box plants. I wish that you, as well as Burnett and others, would do everything you can to bring this about, particularly through talking to various people you know in the east during Paper Week. As far as the southern states are concerned, we will definitely support any meeting to be held there, but I believe it would be best if we could hold one or two meetings in the east before we arrange for a southern meeting. When we eventually decide upon a meeting in the south, we undoubtedly would arrange for it to be held at Savannah, if that should be the most suitable location."

The committee in charge should plan the conference without the help of the local TAPPI section; however, they should contact the local section and ask them if they would like to help in the preparation. It is possible that they can be of most assistance in finding a site or location for the conference. The New York metropolitan area, it was decided, was the logical location for the Fall conference.

K. W. Max agreed to act as chairman to plan the conference. The subject matter will be "General Printing":

(a) Application of scientific methods to specific problems.
(b) Surfacing of board for printing.
(c) Papers may be short and cover one specific point in considerable detail.

6. Consideration of a Fall corrugating conference for 1954 was made. The question also arose as to whether the Fall conference should not be organized on an annual basis. Probable location for the Fall conference of 1954 is the south or southeast.

7. Research Projects: There was some discussion as to the ways in which the committee could provide research projects to TAPPI. Ways in which this could be accomplished were discussed:

(a) The need of a monograph covering all phases of the industry, which could also serve as a textbook for new workers in the industry, is very necessary. It should serve more or less as a textbook much as the "Manufacture of Pulp and Paper" serves.
(b) The committee could possibly utilize the routine control methods and data sheets for the dissemination of information that they obtain.

8. Mel Knack and John Fuko will prepare an outline for the 1954 Annual Meeting. This should be ready for presentation at the Steering Committee meeting at F. D. Long's office at 9:00 a.m., April 23, 1953.

9. The untimely death of Mr. Sperling was mentioned and the committee asked Burt Mendlin to contact Phil Bowen to see if an expression of sympathy to Mrs. Sperling would be in order. He is to act for the committee.

10. The secretary is to contact each subcommittee chairman requesting that he file with the secretary his subcommittee membership, eliminating inactive members and designating a vice-chairman.

W. W. Marteny, *Secretary*

Paper Testing Committee

The Paper Testing Committee held a meeting on Feb. 16, 1953, in the Hotel Commodore, New York City. Those members present were D. H. Newcomb, chairman, R. B. Hobbs, M. S. Kantrowitz, S. C. Fairbanks, Jack T. Ward, P. F. Wehmer, B. L. Wehmoff, and R. W. Wiles.

The chairman made his report of the 1952 activities. The first half of 1952 was spent in reorganizing the Paper Testing Committee. The committee held a Fall meeting in Syracuse, N. Y., and as a result the committee has prepared two new test methods to be submitted to the Standards Committee as suggested methods. These methods are:

1. Blood Resistance of Butcher's Wrapping Paper.
2. Pin Holes in Glassine and Greaseproof.

In addition, the committee studied five standard TAPPI test methods, with the following recommendation:

1. T 440, Alkali Staining Resistance, was reaffirmed as an official method.
2. T 455, Wire and Felt Side of Paper, was advanced to a tentative method.
3. T 462, Printing Ink Permeation, was advanced to an official method.
4. T 469, Flexural Resistance of Fiberboard, was voted to advance to a tentative method, but is being referred to the Testing Div. Chairman for reassignment of responsible committee, and we suggest the Structural Fiber Materials Committee.
5. T 470, Edge Tear Resistance of Paper, was advanced to an official method.

Test methods to be studied for possible revision during 1953:

T 437, Dirt in Paper: This test method was discussed with the view in mind of rewriting this method, especially in regards to the illumination used for making the test. It was also suggested that this committee get in contact with the Pulp Testing Committee and collaborate with them in their studies of the test method for determining the dirt in pulp. To this end, a subcommittee was formed with R. H. Wiles, chairman, and Jack T. Ward.

T 411, Thickness and Density of Paper: Reference was made to the Bureau of Standard Circular 532 titled "Measurement of the Thickness of Capacitor Papers." It was suggested that a review of this report be made with the thought in mind of incorporating a test method for the measurement of thin papers, along with the present standard T 411.

T 451, Stiffness of Paper: The method of testing the stiffness of paper was discussed in light of the new Bureau of Standard's Stiffness Tester. Dr. Hobbs reported that work to date did not indicate any necessary changes to T 451. The Bureau of Standards instrument can only be used on papers up to 80 to 100 lb., 24 × 36—500. Additional correlation work between the new instrument, the Gurley, and the Clark instrument is contemplated. For those interested, there is a report on the new Bureau of Standards instrument in the January, 1953, issue of *Tappi*.

T 433, Dry-Indicator Method for Water Resistance of Paper: It was suggested that The Institute of Paper Chemistry be contacted in regards to the dye that they have developed for this test method; it being pointed out that the quality of the dye influences the results obtained. Further, it was suggested that the scope of this test method be revised to restrict its application to porous papers.

T 459, Waxed Tests for Surface Strength of Paper: The question of the merits of the waxed pick test was discussed. Mr. Kantrowitz reported that Mr. Read and Mr. Whealer of the Lithographic Technical Foundation had been continuing their work on the picking of offset printing papers and that the ASTM was in the process of reporting results of comparisons made between the Dennison pick test and the new Thwing tester. Mr. Kantrowitz and Mr. Wehmhoff will re-

port to the committee the progress of the ASTM committee on this project.

T 454, Turpentine Test for Grease Resistance of Paper: In view of the data uncovered in writing the new test method for determining the pin holes in greaseproof and glassine papers, it was suggested that T 454, Turpentine Test for Grease Resistance of Paper, be modified to redefine the reagents used and also to include the scope of this test method.

T 404, Tensile Breaking Strength of Paper and Paperboard: The present method for testing tensile, T 404, was criticized from the point of rate of loading, and it was suggested that this problem be studied in addition to comparing this test method against government specification UUP-31-B.

Consideration of the establishment of new testing methods:

Bulk of Printing Papers: The testing of the bulk of printing papers was discussed, and it was decided by the committee to work on this subject, in order to write a standard test method for the determination of the bulk of printing papers. A subcommittee was appointed, consisting of Mr. Wehmhoff, chairman, Mr. Kantrowitz and Mr. Hoff.

Ply Adhesion of Laminated Sheets: Inasmuch as ASTM has adopted a test method for the determination of ply adhesion (D 825–52 T), it was recommended that this committee contact the TAPPI Packaging Materials Testing Committee relative to the work they have done on this test subject. It was further suggested that perhaps a joint paper testing and packaging subcommittee could be formed to write a satisfactory test procedure for the determination of ply adhesion of laminated sheets.

Lint of Paper Towels: This subject was discussed, but because of the limited scope and the lack of interest in a test method for the determining of lint of paper towels, this committee decided not to take any action at this time.

Consideration of Routine Control Methods: Jack Ward of Riegel Paper Corp. submitted a routine control method for determining the alkali staining resistance of paper. This method will be submitted to the Testing Div. Chairman for inclusion in the TAPPI routine control method. It is proposed that throughout 1953 additional routine control methods will be studied.

The chairman announced that it was intended to have a Paper Testing Committee meeting some time in the Fall.

D. H. Newcomb, *Chairman*

Microscopy Committee

Three members attended the Microscopy Committee meeting in New York City on Feb. 16, 1953. Present were C. E. Brandon, chairman, N. F. Wilson, and H. C. Koch. Three interested visitors also attended. They were D. V. Lent, D. A. Cameron, and E. R. Wand. These gentlemen have shown an active interest in the committee's projects for several years, and they agreed to assume membership at this time.

It was agreed that the proposed revision of TAPPI Tentative Standard T 401 m-42 should be submitted to TAPPI upon completion of a few changes as follows: It was decided to accept I. H. Isenberg's recommendations regarding nomenclature in the section on morphological characteristics and the identification of western hemlock, southern pine, and Douglas-fir fibers. It was decided to change item 7 under *Apparatus and Materials* to read: Light Source—15-watt daylight fluorescent tube or an equivalent light source. Two changes in the *Quantitative Determination* section were decided upon, that is, the fiber field should be brought into focus 2 or 3 mm. from one of the corners of the cover glass, and counting should be continued until the fibers in four separate lines across the slide have been examined. It was decided to add the following fibers and weight factors to Table I: Bleached flax—0.50, ramie—0.50, esparto—0.50, gum—1.0, manila and jute—0.55, sisal—0.60, straw fo board—0.65, bleached straw—0.35, unbleached bagasse fo board—0.90, and bleached and unbleached bagasse fo papers—0.80. In Table I, the heading *Deciduous Fibers* wa changed to read, *Deciduous Fibers Except Gum and Sulphite* and the items deciduous sulphite fibers and bast and straw fibers were deleted.

The committee projects include completing the method on fiber identification and more work on methods for filler identification, synthetic fiber identification, and identification o printing. No new projects were suggested.

Mr. Brandon read the suggested section or chapter titles for the proposed monograph on "Papermaking Microscopy" and announced that F. L. Simons had agreed to assume chief editorship of this book. The names of persons competent to write the individual chapters were mentioned, but no decisions were made.

It was agreed that application should be made for an appropriation to pay for work to study and develop weight factors. An effort is to be made to find a laboratory available for this work.

Harold C. Koch, *Secretary Pro Tem*

Preparation of Papermaking Materials Committee

The Preparation Papermaking Materials Committee met at the Commodore Hotel on Feb. 16, 1953. Those present were:

F. S. Klein, Chairman, Byron Weston Co., Dalton, Mass.
R. G. Mispley, Crown Zellerbach Corp., Camas, Wash.
W. E. Carlson, Whiting-Plover Co., Stevens Point, Wis.
E. W. Strecker, Esleeck Paper Co., Turners Falls, Mass.
J. F. Theriault, Robert Gair Corp., Uncasville, Conn.
J. P. Bainbridge, Jr., Monsanto Chemical Co., Everett, Mass

Mr. Klein announced that he had invited John Lewis of the Lowell Textile Institute to be a member of the committee but neither Mr. Lewis nor Mr. Simons of the Crane Co. arrived for the meeting. R. J. Proctor of the West Jersey Paper Manufacturing Co., Camden, N. J., has indicated his desire to resign from the committee.

The following major subjects were discussed:

1. *Filler Monograph:* The monograph is essentially complete except for a write-up on clay and the introduction. S. C Lyons, Georgia Kaolin Co., has indicated that he will write up the clay section but has not submitted a manuscript as yet. It was agreed that Mr. Theriault would proceed during this week to contact Mr. Lyons and if he indicated that it would be impossible for him to prepare the article promptly, Mr Theriault would contact others who might be willing to do so. The idea was discussed of preparing the monograph with the exception of clay since this could be a major work in itself but the idea was rejected unless absolutely necessary.

W. R. Willetts, Titanium Pigment Corp., has indicated his willingness to prepare the introduction once the clay section is complete. It was the consensus of the meeting that if the clay section is completed promptly, the monograph should be completed this year.

2. *Significance of Sizing Questionnaire:* The first sizing survey in which a questionnaire was sent to suppliers indicated that mills testing the sizing of writing papers used the pen and ink feathering test and the ink flotation test almost exclusively, and that on printing papers the ink flotation pen and ink feathering, and dry indicator tests were used most frequently. On coarse and other types of paper and paperboard there were a great many more tests used and there was not as much agreement for the use of any particular test on these types of paper.

It was agreed that a questionnaire should be sent to paper mills to determine the exact techniques used, and where applicable, the test results obtained. Because of the magnitude

of the problem of drawing up and circulating and interpreting the questionnaire, it was decided that for this year the efforts would be confined to writing papers and to printing papers. It was requested that Mr. Mispley develop a questionnaire which would first be circulated to committee members for suggestions; simultaneously, Mr. Bainbridge would draw up the list of writing and printing paper mills and the name of the proper person at the mills to receive the questionnaire. This, likewise, would be circulated to committee members for suggestions. Mr. Mispley and Mr. Bainbridge will then send the final results to each other and Mr. Bainbridge would forward both the questionnaire in final form and the list of mills and personnel to Mr. Bingham of TAPPI requesting that the questionnaire be circulated to the given list.

In the meantime, it was requested that Mr. Carlson find out from The Institute of Paper Chemistry if the Institute or a container group is doing any work along this line. If so, the committee should work with that group.

It was further requested that Mr. Mispley contact the milk container and tabulating paper manufacturers for information on the sizing test techniques.

3. *Preparation of Small Materials:* It has been suggested that the committee prepare a monograph or other write-up on methods used for the preparation of small materials, i.e., the dispersing of rosin size, preparation of melamine wet-strength resin, starch, glue, etc.

It was agreed that the chairman would appoint a paper-maker to prepare a list of materials and to contact suppliers of the various classes of materials requesting information on their preparation. In some cases there will be several techniques suggested and it may be necessary for the committee to select the best suggestions and techniques.

J. P. Bainbridge, Jr., *Secretary*

Papermaking (Cylinder) Committee

The Papermaking (Cylinder) Committee meeting was held on Monday afternoon, Feb. 16, 1953 at the Commodore Hotel.

The meeting was called to order by James J. Harrison, chairman of the committee. Mr. Harrison tendered his resignation as committee chairman, and Glen Renegar of Container Corp. of America was selected as the chairman for the year 1953. Mr. Harrison agreed to act as assistant chairman and help in any way possible to further the interests of this committee.

The next order of business was to appoint subcommittees to work on the various areas of interest to this group. The following subcommittees were set up and chairmen appointed.

Raw Materials, A. E. Bachmann, Missisquoi Corp.
Stock Preparation, E. F. Manogue, Gibraltar Corrugated Paper Co., N. Bergen, N. J.
Odor Problems, J. T. Loomer, Robert Gair Co., Uncasville, Conn.
Wet End Operation, S. W. Smith, New Haven Pulp and Board Co., G. C. Ehemann, Ohio Boxboard Co.
Drying and Finishing, K. M. Winrich and L. S. Johnson, Cornell Paperboard Products Co., Cornell, Wis.
Caliper and Weight Control, Lew Ayres, Robert Gair Co., Piermont, N. Y.
End Use Requirements and Testing, A. T. Luey, Sutherland Paper Co., Kalamazoo, Mich.

Following the discussions of the subcommittees and their work, a general discussion was held and it was decided to have a general discussion of papermaking problems on Wednesday afternoon.

One scheduled meeting of the Papermaking (Cylinder) Committee was held on Tuesday afternoon. There were three papers presented at this session which were all very good and well received.

It was proposed that a small meeting of the Papermaking (Cylinder Committee be held this Fall at some central location to determine the progress of the various committees, and also, have discussion meetings. The consensus was that this meeting should be held in September or October at a time which did not interfere with other Fall meetings. This meeting would be a one or two-day session if it can be worked out.

James J. Harrison, *Chairman*

Structural Fibrous Materials Committee

The Structural Fibrous Materials Committee at the Annual Meeting, Feb. 16, 1953, elected officers for the new year. Emile Frederick, Jr., of the Celotex Corp., who has served capably as secretary of the committee for two years has been forced to resign as secretary and from the Steering Committee because of the press of new responsibilities. The committee wished to thank Mr. Frederick for his past assistance in the business of the committee and to wish him the best in his new assignments.

Thure Duvall of Wood Conversion has agreed to serve as secretary of the Structural Fibrous Materials Committee for the new year. Mr. Duvall has served as a regular member of the committee for some years and as a member of the Steering Committee for a year.

R. G. Lacey of the Celotex Corp. was elected to the committee and appointed to take Mr. Frederick's place on the Steering Committee.

E. M. Jenkins of Johns-Manville was elected another year as chairman of the committee.

The committee also elected O. W. Frost of the Simpson Lumber Co. to membership. Roger Shouvlin of Bauer Bros. was elected to replace C. K. Textor also of Bauer Bros. The committee voted to continue the 1952 roster of subcommittee membership and subcommittee chairmen for the new year.

A number of interesting papers were given in Room A on Tuesday morning, the second day of the meeting. All papers had a bearing on Structural Fibrous Materials either as softboard or as hardboard. The authors included such authorities as Wayne C. Lewis of the Forest Products Laboratory, C. K. Textor of Bauer Bros. Co., J. J. Perot of the Flintkote Co., and H. Dale Turner of the Forest Products Laboratory.

All subcommittee meetings of the Structural Fibrous Materials Committee were held on the first day of the Annual Meeting in the Grand Ballroom of the Hotel Commodore. The year's progress was reviewed in each subcommittee and agreements on plans for the coming year reached so that the chairman of each subcommittee would report to the SFMC at the general meeting on Tuesday afternoon. Nearly all the subcommittees reported good progress in the past year.

Subcommittee No. 10, with C. K. Textor as chairman, worked on a comparison of results obtained in evaluating insulating board pulps with the Test Board Former (TAPPI Suggested Method T 1001-sm) and with a modified form of Forming Handsheets for Physical Tests of Pulp (TAPPI Standard T 205 m). Subcommittee No. 10 has completed the problem finding a good correlation between the two methods as regards mullen vs. transverse strength. The Test Board, however, yields more information than the handsheet in that board appearance and probable density are also obtained together with per cent solids for drying indications. The subcommittee was pleased with the TAPPI Suggested Method T 1001 sm method and equipment.

Subcommittee No. 5 with John Campbell as chairman had all but completed their problem in Transverse and Deflection Testing of Insulating Boards. The main point to be settled has been to establish a speed for the separation of the testing jaws. A series of tests was made for the subcommittee by Wayne C. Lewis at Forest Products Laboratory. The committee expects to write a TAPPI Suggested Method for Transverse Testing of Insulating Board in the near future.

Subcommittee No. 4, Drainage Time Testing of Insulating Board Pulps (TAPPI Suggested Method T 1002 sm) had also

made excellent progress. The two drainage time testers that Jules Perot's committee had built with a TAPPI research appropriation have been under test at several committee members' laboratories and the Forest Products Laboratory with good results. A change in the type of valve used to control the water leg was necessary. With this design change the committee believes the TAPPI-SFMC Drainage Time Tester is ready for final comparative tests. Upon completion of the tests the two testers will be circulated to the membership of the main committee for their trial and test. The problem is expected to be completed this year and will include a short-cut method design to provide speedy mill testing for pulp control. The mill method will not have the degree of accuracy of T 1002-sm but will be adequate for control purposes.

Subcommittee No. 8, Light Reflection Measurements, W. L. Scott, chairman has made very good progress during the past year. A suitable apparatus has been finally obtained by alteration of an existing instrument to fit the needs in measuring light reflection from various painted insulating board surfaces. The work has been done with a TAPPI research appropriation and has been followed with interest by other groups and associations. It is the plan of the committee, when work on the instrument is completed, to obtain agreement among the various interested groups and to prepare a TAPPI Suggested Method for the Measurement of Light Reflection from Insulating Board Surfaces.

EDWARD M. JENKINS, *Chairman*

Fibrous Agricultural Residues Committee

The Fibrous Agricultural Residues Committee met at the Commodore Hotel, New York City, on Feb. 16, 1953. The chairman opened the meeting with a brief report on the committee-sponsored 1952 Fall Conference on Fibrous Agricultural Residues held at the Northern Regional Research Laboratory in Peoria on Oct. 27–28, 1952. The main theme of that meeting was a round-table discussion on "Straw Specifications and Grading," with active participation by most of the 70 people attending.

It was voted at the Peoria meeting that the 1953 Fall conference will have as its main theme a round-table discussion on "Crush Resistance and Other Properties of Corrugating Strawboard."

The chairman then discussed changes in committee membership which took place in 1952, and stressed the desirability of spreading the load of committee work more evenly over the membership.

Three desirable sites for the 1953 Fall conference were discussed. Quincy, Ill., Sandusky, Ohio, and Trenton, Ont., have strawboard mills and sufficient hotel capacity to take care of the group generally attending these conferences. Representatives from the two United States' locations stated that their mills would not be in position this coming Fall to sponsor the conference. Mr. Eberhardt informed the committee that it might be possible to hold the 1953 Fall conference in Springfield, Ohio, sponsored by the Bauer Bros. Co. As the Canadian representative of this committee was not present it was decided that if the meeting could not be held in Canada the committee would consider the Springfield, Ohio, site. Later the Canadian committee member reported that a decision on whether the committee meeting could be held in Trenton, Ont., would be made later.

The next subject on the agenda was discussion of a committee-sponsored TAPPI research project. It was pointed out that this project must serve a definite need of the strawboard industry and should be completed within a reasonable time, preferably within a year. Several subjects, all of which had been discussed by the committee in previous meetings, were considered. Among these were:

1. Ways and means of reducing stream pollution from strawboard mills.
2. More accurate estimation of the yield of corrugating pulp from straw.
3. Apparent losses of straw occurring in yard storage of the straw-baled ricks.
4. Improvement of pulping and refining methods in strawboard mills.
5. Slime control in strawboard mills.

After some discussion the committee members present at this meeting selected subject no. 3, the losses of straw in yard storage, as suitable for the TAPPI project. The general plan of attack will be to build up four full-size straw-baled ricks in a mill yard. The straw bales will be tested for moisture and weighed as they are used to build up the ricks. The ricks will be protected from microbial attack in the usual manner by covering the tops with borax. One rick will be torn down after three months' storage, another after six months, the third after nine months, and the fourth after one year. The straw bales will again be weighed and tested for moisture as they are taken from the ricks. The losses in weight, if any, will then be calculated. Observations on the physical condition of the straw and determination of the alkali solubility will be made on representative samples both on stacking and on destacking. This project will require the services of one research man for five two-week periods to supervise the moisture testing, weighing, and sampling, and to make the visual observations on the straw during stacking and destacking, and a final two-week period to write the report.

The chairman and Mr. Eberhardt will contact several universities and institutes to try to obtain a research man for this project. Mr. Burns offered the facilities of his Terre Haute straw yard and yard crew to carry out these experiments. As soon as a qualified research man has been located, the project will be written up and submitted to the TAPPI Executive Committee for action. Attempts will be made to get this preliminary information and TAPPI approval in time to start work on this project with this year's crop (July).

Those in attendance at this committee meeting were: S. I. Aronovsky and E. C. Lathrop, Northern Regional Research Laboratory, Peoria, Ill.; J. E. Atchison, Puerto Rico Pape Products, Inc., Puerto Rico; R. F. Burns and Frank Doenges Weston Paper Co., Terre Haute, Ind.; N. H. Carpenter Muskingum Fiber Products Co., Coshocton, Ohio; L. E. Eberhardt, Bauer Bros. Co., Springfield, Ohio; Earl Knapp, J. R. Little, and D. L. Owen, Hinde and Dauch Paper Co., Sandusky, Ohio; R. A. Springer, Diamond Alkali Co., Painesville, Ohio; and G. A. Zinkil, Central Fiber Products Co. Quincy, Ill.

Training and Education Committee

The Training and Education Committee held its first meeting in Savannah in September, 1952.

The first project was to survey the status of training in the paper industry at the present time. An inquiry was prepared and sent out from the TAPPI office to 220 representative plants throughout the country. To date, 86 replies have been received.

Immediate work ahead of the committee is as follows: (1) Tabulate the information received from the inquiry. This work is now in progress. Upon completion of the tabulation, reports will be prepared for distribution to those participating in the inquiry and an article will be prepared for *Tappi* magazine. (2) Further study of the inquiry by the two subcommittees of the entire committee. The subcommittee to study supervisory and presupervisory training consists of D. D. McKinney, co-chairman, George Arthur and L. M. Lenzi. The subcommittee for further study of nonsupervisory training consists of J. M. Luke, co-chairman G. H. Gallaway, and J. H. Groves.

The next meeting date of the committee has not been se

since this will depend to a large extent on how soon the work outlined above can be accomplished.

J. H. Groves, *Chairman*

Water Committee

The following is a brief summary of the activities of the Water Committee for the past year as well as its plans for 1953.

1. The chapter on water for the textbook "Pulp and Paper Manufacture" was completed.

2. In cooperation with the Conservation Foundation, the water use questionnaire was drawn up and distributed. A summary of the survey was presented at the Water Session on Tuesday, February 17, by Steven Bergen of the Conservation Foundation.

3. The committee sponsored a project at The Institute of Paper Chemistry under Research Grant No. 40. This has been reported on to J. L. Parsons.

The Water Committee plans for 1953 include completion of the project under Research Grant No. 40 as well as a revision of the Water Monograph.

The following is a progress report on Research Project No. , "Development of a Standard Method for the Determination of Suspended Solids in Mill Waste. A Comparison of Buchner and Gooch Methods."

The work was carried out by The Institute of Paper Chemistry under the guidance of B. L. Browning. The method of approaching the problem was established through correspondence, and the outline of attack suggested by the Institute was adopted as the guide in planning and carrying out the work.

A number of determinations of total fixed and suspended solids were made on two types of mill waste, kraft mill, and deinking, under a variety of conditions. The data obtained do not show that significant differences are obtained when using the Buchner funnel as compared to the Gooch crucible method, for the two wastes studied.

As a continuation of the work, it is suggested that the two methods (Gooch crucible vs. Buchner funnel) be compared on a variety of wastes from different sources and representing different types of operation.

A. S. Erspamer, *Chairman*

Engineering Division

This is a summary of our session February 16 at the New York meeting. As usual we had a busy afternoon and again didn't quite finish all the topics on the agenda.

John Lyall, Hubert Parker, and Aux Schnyder were persuaded to continue for this year but asked to be relieved of their chairmanship next Fall, the start of the new season for our Engineering Div. activities. Bill McNally of Link-Belt will take over the Materials Handling Committee; no one has yet been selected for the Engineering Research and Machine Design or the Mill Maintenance and Materials Committees.

J. W. Hemphill took over the Data Sheet Committee chairmanship effective immediately.

Charlie Sibler appointed John Lyall as vice-chairman of the Engineering Division.

Charlie Sibler is to ask Hubert Parker to suggest the person to represent TAPPI on Safety Standards Committee.

Program Reports for Montreal Meeting

Many committees reported on their projects of this past year and what they were working on now; some are doing a terrific amount of work via subcommittees and have made notable contributions.

Here is the status as of the meeting, by the way, at least three Canadians will be authors or co-authors of papers:

Chemical Engineering (J. R. Lientz, Chairman): The program for the Montreal meeting is ready. Nick Shoumatoff also reported his program for the Subcommittee on Digester Corrosion is complete.

Data Sheets (J. W. Hemphill, Chairman): Bumps, who just took over this committee, started off by saying there was a lot to be done and the big question was "how."

His plan is for *each* committee to take over their own data sheets but he will act as coordinator. After all, each committee knows best what is needed and what material can be made available.

Unless Bumps hears otherwise the committee chairman is the representative!

He stressed the necessity of data sheets relating to fundamentals and in a form and with terminology useful to the pulp and paper industry.

Various people suggested a different method of classification of data sheets as it is difficult to locate references now.

Drying and Ventilating (Curt Young, Chairman): Curt hopes that Project 66 relating to drying rates can be finished. A vast amount of data, probably the most complete ever taken, are available in some files; it's now a matter of digging these out, correlating the data, and publishing them.

A second topic, if this report cannot be finished, will be by a Canadian speaker.

Electrical Engineering (Ray Foster, Chairman): Ray reported entire program is complete; a Canadian mill operator will co-author one of the papers.

Engineering Research and Machine Design (John Lyall, Chairman): The Montreal program is complete.

Hydraulics (K. J. Mackenzie, Chairman): The program at Montreal will be a report and discussion on pipe-friction losses of the work currently under way at the University of Maine under TAPPI grant; this is a continuation of the project of the last four years.

Materials Handling (H. A. Stoess, Jr., Chairman): Everything is ready for Montreal.

Mill Design and Economic Aspects (Roland Packard, Chairman): Each year Roland gets a gentle razzing on the title of his committee and I believe he will now change it in self defense.

One very interesting topic for his formal meeting will be on Plant Building Construction by F. M. Kraus of Stadler, Hurter & Co., Montreal. This will include some unique construction methods developed by Stadler, Hurter & Co. for cold climates.

The second topic and the discussion session subject have not been definitely selected.

Mill Maintenance and Materials (A. M. Cooper, Secretary): Mort, reporting for Hubert Parker who was ill, said they were all set for Montreal.

Steam and Power (W. M. Wyburn, Chairman): Bill said everything was all set for the Montreal meeting.

Control and Mill Instrumentation: Nothing definite was decided on what action should be taken. The results of our attendance cards last Fall showed a healthy general interest in this, yet only one mill man indicated enough interest for committee activity.

"Fred" A. T. Hurter of Stadler, Hurter Co., Consulting Engineers of Montreal, and "Steve" J. N. Stephenson, editor of *Pulp and Paper Magazine of Canada*, welcomed TAPPI to Montreal and summarized a series of meetings we had with them and their associates relative to our meeting.

In brief, they are not only offering to help but have shown they mean it; they have already made arrangements for the official plant tour at Dominion Engineering Co., selected the evening and luncheon speakers, and are working on the possibility of a cocktail party sponsored by the Allied Industries in Montreal.

Steve reported they are going to prepare a special pamphlet

—a guide for our visit to Canada. This will include a map of various mill locations with highway directories, points of general tourist information, etc.

1954 AND 1955 MEETINGS

Nothing definitely decided yet but Charlie Sibler indicated that the Philadelphia area would be selected for 1954. Boston has asked for the 1955 meeting.

W. C. BLOOMQUIST, *Secretary*

Steam and Power Committee

I wish to report to you our discussion at the Annual TAPPI Meeting on Feb. 15, 1953, at the Commodore in New York.

Messrs. Sibler and Bloomquist presided and representatives of the various Engineering Div. committees were present and discussed some of the problems pertaining to the next Engineering Div. meeting to be held on Oct. 26–29, 1953, in Montreal, Canada.

Mr. Wyburn presented a report on the Steam and Power Committee program.

For the final record and to confirm the preliminary data which we handed to Messrs. Sibler and Bloomquist, we record the following:

Main Program: "Functioning of the Boiler Code as it Pertains to the Paper Industry," by E. C. Korten, Assistant Chief Engineer, Hartford Steam Boiler Inspection and Insurance Co.

"'Case History' on the 850 P.S.I. Ga. Topping Installation at St. Regis Paper Co., Mill, Deferiet, N. Y.," by representatives of Chas. T. Main, Inc., and the St. Regis Paper Co.

Round-Table Discussion Topic: "Interpreting Performance Curves of Single and Double Extraction Turbines and the Use of Heat Rates as a Method of Calculating Power Costs," by J. Gottlieb, Consulting and Application Engineer, Westinghouse Electric Corp.

We believe this "Case History" topic will be of interest to all and is a timely story. Mr. Emery, Plant Engineer, may be one of the speakers and he tells me that the installation is a very interesting one. The topping installation modernized a 40-yr.-old power plant.

J. GOTTLIEB, *Secretary*

Engineering Research and Machine Design Committee

The meeting of the Engineering Research and Machine Design Committee was called to order at 1:45 p.m. on Monday, Feb. 16, 1953, in the South Room of the Commodore Hotel by the chairman, John Lyall. After a brief review of the October meeting we proceeded with the business of the day.

A. J. R. Curtis gave the report of the Subcommittee on the Organization and Operation of the Engineering Research and Machine Design Committee. The report ended with the following motions which were promptly approved by the committee.

1. Be it moved that the stated objective of the Engineering Research and Machine Design Committee shall be to promote advances in the pulp and paper industry by compiling engineering information influencing machine design from all available sources and presenting it to the industry in a clear, consise, and useful form.
2. Be it moved that a *Project Control Subcommittee*, consisting of a vice-chairman and two members, shall be appointed by the chairman of the Engineering Research and Machine Design Committee with responsibilities as outlined generally in the foregoing discussion.
3. Be it moved that a *Program Subcommittee*, consisting of a vice-chairman and at least two members, shall be appointed by the chairman of the Engineering Research and Machine Design Committee with responsibilities as outlined generally in the foregoing discussion.
4. Be it moved that, starting in February, 1955, one new replacement be appointed annually for the Project Control and Program Subcommittees, and an old member of the subcommittee be appointed to replace the retiring vice chairman.
5. Be it moved that each Fall TAPPI meeting the committee shall recommend to the head of the Engineering Div. two names of men proposed for committee chairman and secretary.
6. Be it moved that this report, as revised after committee discussion, be accepted into the committee minutes to serve as a *general guide* for future operations of the committee.
7. Be it moved that the subcommittee consisting of J. R. Curtis, Elmer Macklem, K. W. Brenner, and Leon Savage be dissolved as of this meeting date.

With the approval of the above motions the Subcommittee on Organization and Operation is dissolved with our thanks for a job well done.

To comply with the above motions E. A. Crawford was appointed vice-chairman in charge of the Project Control Subcommittee and J. R. Curtis was appointed vice-chairman in charge of the Program Subcommittee.

B. The next subject for discussion was the program for the 1953 Engineering Conference to be held in Montreal, Que., Canada, at the Sheraton-Mount Royal Hotel on October 26 to 29.

Three papers will be presented at the morning session starting at 10:30 a.m., Monday, October 26:

1. "Constant Tension Devices," by George Ehemann and R. C. Berger.
2. "The Application Aspects of Paper Machine Differential Drives." (Author not selected.)
3. "Stress-Strain Relationship in Fourdrinier Wires," by John D. Lyall.

A paper on "Drier Drainage" by J. B. Gouch was referred to the Drying and Ventilating Committee for its consideration. A second paper on "Hydraulics of Forming Boards" by J. B. Gouch was referred to the Hydraulics Committee for its consideration.

Due to lack of time a paper on "Vacuum Transfer" was not considered at this meeting.

Since three papers are being presented in 1½ hr. the speaking time for each will be about 20 min. The speaker need not present this paper word for word but a 20-min. synopsis should be presented and the entire paper will be published in *Tappi*.

We believe that preprints are desirable and we are requesting the authors to have their papers available by June 1 so that these can be made in time for distribution before the meeting.

C. Next was the reports of the subcommittees.

1. Stock Control Systems: Larry Moore reported that no work had been completed because of his change in status from a mill employee to a supplier. He thought that it might be better to assign a new chairman for the subcommittee. It was the opinion of the committee that since work had progressed this far it would be better to have Larry complete the project.

Data will be compiled and a report issued at next February's meeting so that a paper can be presented to terminate the project.

2. Rubber Roll Committee: K. W. Brenner reported that the "Suggested Method of Determining Hardness of Rubber Covered Rolls" was rejected by the Standards Committee. Change will be made and it will be resubmitted at an early date.

The present project is to measure the pressure of nips between rubber rolls. To date a satisfactory method has not been found.

3. Methods of Estimating Costs of Engineering Projects: The work of our subcommittee has, for the present at least, fallen into the pattern of a one-man job. The reason is that we have been more or less floundering around trying one approach after another to see: (a) what type of information is obtainable and, (b) if it is made available, would the engineers and technical people in the paper industry use it? There is nothing more futile to a committee than to de-

op a project of this nature and later find the attitude of the industry apathetic toward the entire venture.

As we understand the original problem, it is desired to make available to the paper mill plant engineer, technical staff, or executive, information to simplify preparation of preconstruction cost estimates, same to be accurate within a ± 20%. A search of current literature devoted to the pulp and paper industry disclosed almost no information dealing with the subject of costs. The chemical industry has done a great deal along these lines in making available to engineers in their own industry information on costs and cost estimating. Very little of their cost information would seem to fit into our particular industry without considerable remapping. Our committee does not have time to do this and as a result we are dependent on what we can locate here and have and arrange to have republished in *Tappi*.

The first two articles our committee submitted dealt with Pipe Cost Estimation and appeared in the October, 1952, issue of *Tappi*. One hundred preprints of the articles were distributed at the Chicago meeting. We have had many requests for more reprints from various sources, including a request only last week from a technical institute in Sweden.

These responses have encouraged us to continue in our search for more material. We located and have arranged with Mr. Macdonald to republish a very fine article on "Costs of Field Erected Storage Tanks." This should appear in March or April *Tappi*. Following that will be an article on instrumentation costs now being especially prepared for us by the Foxboro Co. The above, then, is the pattern our committee is following. We hope to be able to submit one article for each issue of *Tappi*. By so doing we should, in time, be able to assemble the articles and issue them in the form of a booklet of reprints. These might be sold for a nominal sum to cover the cost of reprinting.

The committee welcomes and solicits the cooperation of engineers in allied industry companies and in pulp and paper mills in making available for publication in *Tappi* information on construction and equipment costs.

4. Constant Tension Device: George Ehemann presented a draft of a paper for criticism. It will be reviewed and a paper presented in Montreal this year.

5. Machine Measurements: The project is tension on felts. Mr. Clink has investigated methods for making a portable device for measuring felt tension. At the present time he is considering ways for making it available for various machines.

W. S. Miller of the Gulf Oil Co. discussed the possibility of our committee taking on a project on lubrication systems for paper machines.

E. M. May of the Bowser Corp. also requested that the project be considered.

After much discussion the project was referred to Mr. Crawford for consideration by the Project Committee. It was recommended that if the project was accepted the following should be considered.

1. Personnel should be selected with the thought that this group might be turned into a separate committee of the Engineering Div.
2. That the committee operate jointly with the American Society of Lubricating Engineers, 343 S. Dearborn St., Chicago, Ill.
3. The Project Committee to consider the scope of the project and report in October, 1953.

The members of the committee present were:

R. D. Irwin, M-H Regulator Co., Philadelphia, Pa.
R. M. Leighton, Newton Upper Falls, Mass.
J. R. Curtis, Scott Paper Co., Chester, Pa.
Leon Savage, 4212 Stuart Ave., Richmond, Va.
Philip A. Goldsmith, The Pusey & Jones Corp., Wilmington, Del.
B. M. Hutchins, The Rust Engineering Co., Pittsburgh, Pa.
Dwight E. Jones, E. D. Jones & Sons Co., Pittsfield, Mass.
K. Brenner, Eastman Kodak Co., Rochester, N. Y.
G. E. Clink, Sandy Hill, Hudson Falls, N. Y.
G. H. Spencer, Torrington Co., Torrington, Conn.
H. C. Merritt, Downingtown Mfg. Co., Downingtown, Pa.
L. A. Moore, Black-Clawson Co., Hamilton, Ohio
G. C. Ehemann, Ohio Boxboard, Rittman, Ohio
R. C. Berger, General Electric, Cleveland, Ohio
J. C. Harper, Downingtown Manufacturing Co., Downingtown, Pa.
W. B. Miller, Gulf Oil Corp., Pittsburgh, Pa.
E. M. May, Bowser, Inc., 420 Lexington Ave., New York 17, N. Y.
E. A. Crawford, Continental Paper Co., Ridgefield Park, N. J.
C. E. Macklem, Beloit Iron Works, Beloit, Wis.
H. G. Ingraham, Chas. T. Main, Inc., Boston, Mass.
J. D. Lyall, Armstrong Cork Co., Lancaster, Pa.

R. D. Irwin, *Secretary*

Electrical Engineering Committee

The Electrical Engineering Committee met Tuesday afternoon, February 17, at the Hotel Commodore in New York City and the following members were in attendance:

R. R. Baker, Westinghouse Electric Corp.
Ray Foster, Champion Paper & Fibre Co.
N. L. Danforth, St. Regis Paper Co.
E. F. Greive, Allis-Chalmers Mfg. Co.
G. W. Knapp, General Electric Co.
J. L. Van Nort, Reliance Electric & Engineering Co.
I. Witham, Byron Weston Co.

The following program was adopted for the Montreal meeting:

General Session: "Experience with Grounding," by R. H. Kaufmann, General Electric Co.; "Analysis of Down Time," by R. F. Sorenson, Union Bag & Paper Corp.
Round-Table Session: "Preliminary Report on Chippers," by M. J. Osborne, Bowaters Southern Paper Co.; "Preliminary Report on the Power Requirements of Supercalenders," J. L. Van Nort, Reliance Electric & Engineering Co.

Analysis of Down Time

Mr. Sorenson wrote a letter to Mr. Foster dated Feb. 13, 1953, on his down time project, requesting the advice of the committee members at the meeting. The letter was circulated and it was generally agreed that Mr. Sorenson's plan was excellent and that he should proceed accordingly.

It was suggested that the following mills might be cooperative in giving Mr. Sorenson the information he needs on the performance of electric sectional drives, and were representative of the several types:

St. Regis Paper Co., Bucksport, Me. (N. L. Danforth)
St. Regis Paper Co., Pensacola, Fla. (A. O. Mortenson)
Container Corp., Fernandina, Fla. (Mr. Digby)
Byron Weston Co., Dalton, Mass. (I. Witham)
New York & Pennsylvania Co., Lock Haven, Pa. (Harry Fox)
Champion Paper & Fibre Co., Canton, N. C. (R. W. Foster)
Union Bag & Paper Corp., Savannah, Ga. (R. F. Sorenson)
Oxford Paper Co., Rumford, Me. (J. L. Grady)
Kimberly-Clark Corp., Neenah, Wis. (Russell Johnson)
Hollingsworth & Whitney, Mobile, Ala. (Mr. Smith)
Hammermill Paper Co., Erie, Pa. (A. S. Goodrich)
Ohio Boxboard Co., Rittman, Ohio (George Ehemann)
Crocker Burbank Co., Fitchburg, Mass. (Bigelow Crocker)
American Coating Mills, Elkhart, Ind. (Earl Staechel)

Mr. Baker is also going to check the U. S. Gypsum Co. to see if they would be interested in reporting and will advise Mr. Sorenson.

The above list is representative of many different types of paper machines, widths, speeds, and grades. Several of these mills may not be willing to cooperate but it is hoped that Mr. Sorenson will be able to get data from six or eight companies.

It was the consensus of the committee that for the preliminary investigation of Mr. Sorenson's subcommittee no attempt should be made to generalize the results unless it looked completely feasible. Instead, the committee suggested that all of the information in his letter should be obtained on each one of the machines checked and in addition the following should be included: age of drives; design range as well as

operating range; maintenance schedule and personnel, including a general description of maintenance program, and availability of spares.

Following a study of individual cases this year, it is hoped that additional mills will cooperate and some generalizations could be made on down time and maintenance man-hours in 1954. However, it may never be possible to set these up for any and all conditions.

Cable Report

There was considerable discussion about the outstanding report that Mr. Mortenson and his subcommittee have prepared and its usefulness. Mr. Bloomquist, the general secretary of the TAPPI Engineering Div., stopped in to tell the committee meeting that he had just returned from the Northwest and found that the mills out there were regarding the report as the authority on cable applications. Mr. Foster stated that he had several telephone calls on it. There seemed to be general agreement that this report represents one of the biggest and most important projects of the Electrical Committee to date. Committee members felt that in addition to putting it into data sheet form for ready reference, it should also be made into reprints by TAPPI so that the full story would be generally available. In view of this it was decided by the committee to hold up publication of the report until some modifications resulting from the Chicago discussions and subsequent correspondence that Mr. Mortenson has had, could be included. It was hoped that Mr. Mortenson could find time to do this by July so that we can report in the October meeting that it had been published and data sheets were under way.

Fourdrinier Report

Data sheets based on this report have been circulated to the committee members for comments. The group at the committee meeting felt that they were satisfactory except that a statement should be added to the effect that a higher flat box vacuums the ability of the nip between the wire and the couch rolls to transmit the power required should be investigated and that auxiliary couch rolls, as well as main couch rolls, were being used to meet the larger power requirements.

GEORGE W. KNAPP, *Secretary*

Digester Corrosion Subcommittee

I believe we had a very successful series of meetings on digester corrosion last week. All of our members were present with the exception of two. The following duplicated material was distributed to the members: (1) Annual Report of the TAPPI Digester Corrosion Subcommittee, Feb. 16, 1953, (2) Outline of Work for Armour Research Foundation, (3) Manual of Digester Inspection—Suggested Contents, and (4) Suggested Committee Procedures.

I would like to express my appreciation to those who were present and contributed to these meetings and particularly to the authors of the most interesting and excellently presented papers. I sincerely regret that the room assigned for these presentations proved to be too small for the audience which attended, which was definitely a lack of foresight on my part.

At our luncheon meeting on February 16 it was agreed to go ahead with the manual on digester inspections. It was agreed that it would be in the form of a regular TAPPI monograph. It was also announced that Claud Christiansen has been added to our committee as a liaison member to represent the Pulp and Paper Research Institute of Canada and that Hank Peters is serving as an understudy for Len Williams for the time being. A revised membership list will be distributed in the near future.

On February 18 we had a very interesting discussion with T. E. Caywood of Armour Research Foundation. According to Herb Teeple's latest count, we have sent Armour data on 137 digesters from 12 different companies, and we still have a few more to come in. It was agreed that March 15 would be the deadline for submitting material on additional digesters.

I believe that everyone present felt that although this is not an easy project, we have every hope that Mr. Caywood's work will lead to useful and important results. The question of a committee meeting at Chicago in May was left open.

Herb Teeple will undoubtedly distribute formal minutes of last week's activities in the near future.

1. *Authorized Projects:* The subcommittee has received substantial support for its urgent work in the form of two separate research grants from the Association:

Research Project No. 36—Analysis of Digester Corrosion (based on corrosion questionnaires) by Battelle Memorial Institute. Project complete. Results published in *Tappi* 35, No. 8: Sept., 1952, pp. 403–409.

Appropriation	$4000.00
Total billing	2820.01
Unexpended balance	$1179.99

Research Project No. 50—Analysis of Digester Corrosion (based on wall thickness measurements) by Armour Research Foundation.

Appropriation	$6000
Contract signed	Jan. 29, 1953
Results to be presented	Oct. 28, 1953

2. *Presentation of Papers:* The five papers on digester corrosion to be presented at the Annual Meeting on Thursday morning, Feb. 19, 1953, are part of a list of 18 papers projected at the meeting of the subcommittee in October, 1952. At present it is expected that this program will be continued as follows at the Engineering Conference at Montreal, Oct. 28, 1953:

(a) "Comparative Analysis of Digester Corrosion Measurements," by T. E. Caywood, Armour Research Foundation.
(b) "The Cause or Causes of Corrosion in Alkaline Pulping Equipment," by Claud B. Christiansen, Pulp & Paper Research Institute of Canada.
(c) "Cathodic Protection of Digesters," by E. W. Keith, Penobscot Chemical Fibre Co.
(d) "Safety Evaluation and Protection of Digesters," by insurance company representatives.

These papers will be discussed during the discussion period on the same day.

The following papers are tentatively scheduled for presentation at the Annual Meeting in February 1954:

(a) A paper by Union Bag & Paper Corp.
(b) A paper by Crossett Paper Mills.
(c) A paper on digester inspection equipment and techniques.
(d) "The History of Carbon Brick Linings in Kraft Digesters," by Beaumont Thomas, Stebbins Engineering and Manufacturing Co.

3. *General Objectives of the Subcommittee:* Development of practical solutions to the urgent problem of corrosion in alkaline pulping digesters by:

(a) Discovery of economically feasible modifications of operating conditions, equipment, and practices to reduce the intensity of digester corrosion.
(b) Establishment of a sound technological foundation for the economic selection of digester construction materials and design under specific operating conditions, and development of new, more satisfactory materials and methods of design.
(c) Establishment of reliable procedures, for systematically detecting the progress of corrosion in actual digesters, evaluating their safety status, standardization of safety devices, and repair of affected areas.

While it is too early to report any final results, there are a number of promising indications which warrant confidence that these objectives will be fully achieved.

4. *The Armour Research Foundation Project:* This is the subcommittee's major current project. It was made pos

ible by the fact that a large proportion of the companies in the industry have adopted a systematic program of repetitive wall thickness measurements as recommended by the subcommittee (*Tappi* 35, No. 7: July, 1952, pp. 136A–137A) and have been willing to contribute their accumulated data to the subcommittee for analysis. This wealth of quantitative data, unique in the world, will be subjected to intensive statistical analysis to determine (a) the magnitude, characteristics, and incidence of digester corrosion according to various sectors of the industry and various categories of digester types and pertinent process variables, and (b) the best criteria for evaluating operating safety and predicting repairs and replacements. Results of this investigation will determine the specific course of the future work of the subcommittee.

5. *Future Projects:* Among various future projects being considered, the major ones definitely planned are preparation and publication of a comprehensive manual on digester inspection, and a comprehensive annotated bibliography.

6. *International Cooperation:* Close personal contact and interchange of reports have been maintained with the digester corrosion research group at the Pulp and Paper Research Institute of Canada, undoubtedly for our mutual benefit.

7. *Membership:* The subcommittee consists of 18 members including 9 from the pulp and paper industry, representing all its geographical sectors, 7 representing digester materials producers and fabricators, and 2 representing insurance companies.

MANUAL OF DIGESTER INSPECTION—SUGGESTED CONTENTS

1. Purposes of inspection. Scheduling. Duties of inspector.
2. Equipment—platform, jigs, gages, accessories.
3. Preparation for inspection. Safety precautions.
4. Vessel design data. Corrosion and repair history.
5. Visual inspection. (a) Metal surface. (b) Brick lined.
6. Thickness measurement techniques.
7. Inspection of piping.
8. Overpressure safety systems.
9. Operating conditions and practices affecting corrosion.
10. Methods of repair.
11. Interpretation of results.
12. Preparation of reports.

Appendices

a) Calculation of allowable pressures.
b) Calculation of corrosion rates.
c) Thickness conversion tables.
d) Accuracy of measurement.
e) Report forms and checklists.
f) Photography.
g) Auxiliary methods of corrosion testing.
h) Inspection time studies.
i) Digester construction materials and fabrication.

PROSPECTUS FOR TAPPI MONOGRAPH ON INSPECTION OF DIGESTERS

I. *Introduction* (by N. Shoumatoff and H. O. Teeple):

(a) Historical sketch.
(b) Purposes of inspection.
  1. Safety to personnel.
  2. Conservation of plant.
  3. Provide information to assist engineering planning.
(c) Planning, administering, and scheduling an inspection program.
(d) Duties of inspector.
  1. Observation of condition of vessel.
  2. Measurement and analysis of thicknesses.
  3. Presenting recommendations and reports.
4. Supervision of repairs.
  5. Cooperation with corrosion prevention and testing programs.

II. *Equipment* (by C. W. Smith and J. J. Goss):

(a) Platforms.
(b) Jigs for locating test points.
(c) Thickness gauges.
(d) Accessories.

Description, illustrated with outline drawings and photographs, and discussion of applications of the items in each category.

III. *Preparation for Inspection* (by C. W. Smith and J. J. Goss): Discussion of procedures for preparing a digester for inspection, under various conditions of operation, with special emphasis on safety precautions for the inspector, and on systematic location of test points for sequential readings.

IV. *Essential Vessel Data* (by R. A. Davis and H. F. Peters): Discussion of the items of information and sources of same, pertinent to a particular vessel, with which an inspector should familiarize himself before making an inspection, namely (a) design data and details, (b) inspection records, (c) repair history.

V. *Visual Inspection:*

(a) Metal surfaces—by W. B. Parker and H. M. Canavan.
(b) Carbon brick linings—by B. Thomas.

Detailed, step-by-step procedures for visual inspection—the most important part of the inspector's job.

VI. *Thickness Measurement Techniques* (by Peter K. Bloch): Outline of the theory of the different basic types of measuring instruments used in digesters, and their limitations. Detailed procedures for taking measurements, both for routine inspection and investigation of unusual conditions.

VII. *Inspection of Piping* (by F. E. Hutton): Definition of reasonable scope of digester inspector's responsibilities with respect to fittings and external piping forming an integral part of the pressure system of a particular digester. Recommended practices for inspection of same, both for routine and unusual conditions. Includes outline of the different types of design details used for fittings, and type of attack to which they are subject.

VIII. *Overpressure Safety Systems* (by W. B. Parker and H. M. Canavan): Types and design details of safety relief valves. Pressure setting and capacity selection recommendations and rules. Proper methods of installation in the system. Methods of testing and recommended procedures in connection with digester inspections.

IX. *Operating Conditions and Practices Affecting Corrosion* (by F. W. Flynn and W. J. Shelton): Discussion of those operating conditions and practices which are pertinent to the inspector's responsibility for safeguarding the digester, and with which he should therefore be familiar so that he may make intelligent recommendations in his inspection reports.

X. *Methods of Repair* (by E. W. Hopper): Description of methods and applicability of digester repairs, and discussion of good practices with respect to each. Includes welding, field lining, patching, field stress relieving, magnafluxing.

XI. *Interpretation of Results* (by T. E. Caywood): Comprehensive methodology for the routine analysis of inspection results with emphasis on the quantitative aspects, that is, criteria for location of critical areas, evaluating safety status, and predicting remaining service life.

XII. *Preparation of Reports* (by N. Shoumatoff and H. O. Teeple): Discussion of the items of information to be included in inspection reports, and of their presentation in a systematic way using graphic, tabular, and textual methods.

APPENDICES

(a) *Calculation of Allowable Pressures* (by W. B. Parker and H. M. Canavan): Applicable extracts from Construction Codes and National Board Rules. List of State and Provincial Codes and Laws. Recommended procedures for inspector. Tables of allowable pressures and thicknesses for

various commonly used diameters and materials of construction.

(b) *Calculation of Corrosion Rates* (by T. E. Caywood): Background material on statistical methods used for determining corrosion rates from sequential thickness measurements, with illustrative examples.

(c) *Accuracy of Measurement* (by T. E. Caywood): Analysis of actual data to indicate the reliability of routine inspection results, relative influence of the different sources of error, and relative accuracy of different instruments.

(d) *Thickness Conversion Tables* (by Peter K. Bloch): Tables useful for determination of digester wall thicknesses from frequency readings on ultrasonic instruments.

(e) *Report Forms and Checklists* (by Entire Membership of Digester Corrosion Subcommittee): Recommended blank forms for recording graphic and tabular material after inspections, also checklists summarizing the recommendations of each of the major chapters of the monograph. It is visualized that this section, together with appendix (d) and the tables from appendix (a) could be reprinted separately for wider distribution in the field.

(f) *Photography* (by F. E. Hutton): A general discussion, illustrated with outstanding photographs on the uses of photography as a tool of the digester inspector.

(g) *Auxiliary Methods of Corrosion Testing* (by Merrill A. Scheil): Brief discussions of different types of corrosive attack occurring in different types of metals and types of construction, methods of testing digester metals both in laboratory and field, with special emphasis on the latter: rack samples, trepanning, chemical and metallographic analysis, bending and tensile tests, embrittlement detectors, electric potential measurements. Examples of pertinent results obtained.

(h) *Inspection Time Studies* (by C. W. Smith and J. J. Goss): Data on well-established time and personnel requirements for actual inspections, also of preparatory phases.

(i) *Digester Construction Materials and Fabrication* (by H. F. Peters, Metals, R. A. Davis, Metals Fabrication, and B. Thomas, Carbon Brick Lining): Background material on properties for materials used in digesters and associated manufacturing and fabricating processes.

(j) *Annotated Bibliography on Digester Corrosion* (by S. J. Baisch and R. P. Whitney): Condensation, revision, and bringing up to date of the bibliographies published by T. T. Collins.

Discussion

The monograph is to be a major project of the TAPPI Digester Corrosion Subcommittee for the year 1953. Almost all committee members have been assigned to prepare certain sections according to their specialized experience and interests. All authors are committee members with the exception of T. E. Caywood of Armour Research Foundation and Peter K. Bloch of Branson Instruments, Inc. The scope of the monograph is based on a broad conception of the functions of an inspector, and will set forth detailed procedures for carrying out each of these functions as well as appendices in which pertinent background information will be compiled. Thus the monograph will be considered as a fulfillment of the third general objective stated in the committee's report of Feb. 16, 1953, as follows: "Establishment of reliable procedures, for systematically detecting the progress of corrosion in actual digesters, evaluating their safety status, standardization of safety devices, and repair of affected areas." This monograph will be an outgrowth of the systematic approach to digester inspection as developed in the committee's "Digester Inspection Report Data Sheet," *Tappi*, July, 1952.

Nicholas Shoumatoff, *Chairman*

Armour Research Foundation Project

The following is a report of the meeting of T. E. Caywood of the Armour Research Foundation with TAPPI Digeste Corrosion Subcommittee on Feb. 18, 1953. Those presen were:

N. Shoumatoff, West Virginia Pulp & Paper Co., Chairman c Subcommittee
H. O. Teeple, International Nickel, Secretary of Subcommitte
C. B. Christiansen, Pulp & Paper Research Institute of Canad
R. A. Davis, Chicago Bridge & Iron Co.
H. F. Peters, Lukens Steel Co.
S. J. Baisch, Thilmany Pulp & Paper Co.
W. B. Parker, Hartford Steam Boilers Mfgrs. & Ins. Co.
E. W. Keith, Penobscot Chemical Fibre Co.
J. G. Sylvester, Mutual Boiler & Mach. Ins. Co., Alternate fo H. M. Canovan of same company
E. H. Schmidt, A. O. Smith Corp., Alternate for M. A. Schi of same company
C. W. Smith, Crossett Paper Mills
J. R. Lientz, Union Bag & Paper Corp.
F. W. Flynn, Crown Zellerbach Corp., Camas, Wash.
E. W. Hopper, Crucible Steel Co., Pittsburgh, Pa.
T. E. Caywood, Armour Research Foundation
C. R. McCully, Armour Research Foundation (until 10.3 a.m.)

The meeting was opened and conducted by Mr. Shouma toff. After a brief discussion of various topics relevant t some of our questions, he presented a sponsor's prospectus fo Project I 899-9. Our research agreement was read alou and discussed. Mr. Caywood indicated the present AR plans for the project. Meeting adjourned at noon with te members eating luncheon together. A more detailed de scription of these events follows below.

1. Introductory Discussion

Audigauge: Instrument involves the use of a crystal whic acts as an acoustic source and receiver. The crystal is place on tank wall and excited. Excitation frequency is change until resonance between transmitted signal and signal re flected from far surface of tank wall is detected. Wall thick ness is obtained from resonance frequency and sonic cor stants of the metal. It was stated that the scale division on the device correspond to about 0.012 in. in wall thickne so one may expect the accuracy and precision to be withi this order. The device is presumably guaranteed to $11^1/_2\%$ Apparently the first use of the device was in 1948. Crosset Paper Mills acquired one at this time. They have been mak ing measurements on a six-month schedule since 1950. M Shoumatoff indicated he would obtain a copy of the instruc tion book on the Audigauge for us.

Corrosion vs. Stress: Two of the members of the sub committee (C. W. Smith and one other, I think either Sylveste or Schmidt—T. E. C.) presented the thesis that the highe an area is stressed the more it corrodes. Some of the othe members were skeptical on this point.

Desired Accuracy: The principal reason for wanting t measure digester corrosion lies in the desire to predict th life of a digester. If this can be done to the nearest yea then suitable steps can be taken to amortize digesters an replace them when necessary.

Importance of Various Variables: It was originally though that changes in steels used in digesters would account for major change in corrosion in past few years. Now change in the process variables are felt to be the more important cor tribution to the change in corrosion. New evidence seem to indicate that the most dominant variable contributing t corrosion is the location within a given digester.

Use of Data from New Digesters: If only one set of meas urements is available from a digester, one could assume th original or initial wall thickness to be constant. Presen specifications allow variations in thickness of the steel plat for the walls to be -00 to $+10\%$. The Canadians have a sumed a nominal thickness of $+4\%$ of specifications.

2. Presentation of Corrosion Committee's Prospectu for I 899-9

Some of the committee had met previously and approve a prospectus for Project I 899-9.

The outline of work for Armour Research Foundation follows:

1. What magnitude of corrosion rate variation can be attributed to differences in metals and under what conditions?
   (a) Old vs. new carbon steels.
   (b) Rimmed vs. semikilled vs. killed steels.
   (c) Alloys vs. carbon steels.
   (d) From plate to plate or point to point within a vessel.

2. What magnitude of variation in general and local attack can be attributed to differences in process chemistry?
   (a) Variation in sulphidity at different levels.
   (b) Other liquor components.
   (c) Type of wood.
   (d) Type and amount of make-up.

3. What amount of corrosion rate variation exists which apparently cannot be explained by above hypotheses?
   (a) Among different geographical regions.
   (b) Among different mills in same region.
   (c) Among different digesters in same mill.
   (d) Same digesters at different times.

4. What magnitude of localized attack can be attributed to different operating conditions and procedures within a vessel?
   (a) Vapor vs. liquid phase.
   (b) Scaled vs. unscaled areas.
   (c) Horizontal asymmetry apparently due to chip loading, liquor filling, or impingement.
   (d) Erosion when blowing digester.
   (e) Fittings.
   (f) Areas of maximum stress.

5. What are the best procedures of analyzing inspection records to determine and predict.
   (a) Corrosion rates?
   (b) Thickness?
   (c) Remaining service life?

It was felt by some that items Nos. 2 and 4 were the most dominant, but these people admitted that this would come out as a result of the study.

It was noted that all the items except No. 5, were implicitly given in the proposal submitted by ARF. The committee indicated that they would be glad to consider this item as beyond the scope of the present contract. It was indicated that funds were available and that a formal request would come to us for the addition of this item. They have in mind a separate report, on this topic, suitable for inclusion in a handbook on digester corrosion.

3. Discussion of Research Agreement on Project I 899-9

The entire research agreement was read aloud by Mr. Shoumatoff and the following points were discussed in some detail:

Section III: It was noted that no allocation for travel was made in the original proposal but that this item would be borne by TAPPI.

Section V, on steering committees: The entire digester corrosion subcommittee would like to be considered a steering committee for this project. In order to fulfill this section, Mr. Teeple and Mr. Shoumatoff would constitute the nominal steering committee and they would be responsible for transmission of information and questions to the rest. It was agreed that nearly all of the functions of a steering committee would be performed by correspondence. Mr. Teeple was invited to visit ARF on March 20, during a business trip to Chicago.

Section VI, on reports: No formal reports were to be submitted before the final report. Close informal contact was to be kept with Messrs. Teeple and Shoumatoff via correspondence. ARF would initiate correspondence on the progress of the project as progress is made.

Section IX, on publicity, was explained briefly as included to protect the Foundation from publicity violations. It was agreed that committee business relevant to Project I 899-9 need not be cleared through ARF.

Section XI, in case of funds expended before allotted time or before project is completed: We reaffirmed that suitable notice would be given TAPPI if this happened.

Mr. Teeple pointed out that it looked like we would receive data on about 200 digesters in all. It was admitted that this was in excess of the 100 digesters mentioned in our proposal, but that they would like to have us treat all 200.

4. ARF Plans for Project I 899-9

These plans are given in essence in our proposal. Work was expected to start about March 2. It is hoped that by April 1, we would have completed our familiarization phase and be prepared to have the TAPPI data placed upon IBM cards to investigate the various possibilities of the analysis, a process which may be described by "thinking with IBM cards." In the latter part of April or early May we will be prepared to do the complete analysis using all the cards.

One of our first jobs would be to prepare an "inventory" of the data in our possession. This inventory would enable us to better assimilate the data and lay out our analysis. Copies of this inventory would be presented to the steering committee.

T. E. Caywood

Alkaline Digester Corrosion

In an effort to locate digester corrosion data which would be of further use by the Digester Corrosion Subcommittee, the committee drew up a questionnaire which was sent to the various companies operating alkaline mills in the United States.

The questionnaire was sent to 48 kraft pulp producing companies and 15 soda pulp producing companies. The returns are tabulated in Table I.

Table I. Questionnaire Returns Summary

Company—type	*Sent out*	*Returned*	*Percent returns*
Kraft	48	28	58
Soda	15	9	60
Total	63	37	59

It is interesting to note the per cent returns were practically the same in all three categories. It is presumed the returns were filed by those mills who either had a strong favorable interest in the committee's work or by those who were interested in providing some comments. Those mills which did not file a return represent a group of companies which probably should examine more closely their digester corrosion problem.

Table II shows a breakdown of the manner in which the questions were answered:

Question	*Yes*			*No*		
	Kraft	*Soda*	*Total*	*Kraft*	*Soda*	*Total*
1. Do you measure the wall thickness of your digesters using an Audigage or other similar device?	22	7	29	6	2	8
2. If so, do you have a systematic procedure for locating the points of measurement for regular repetitive thickness readings?	18	6	24	10	3	13

Question	Yes — Kraft	Yes — Soda	Yes — Total	No — Kraft	No — Soda	No — Total
3. Do you have digesters for which you have two or more sets of readings obtained by the use of a systematic procedure?	16	4	20	12	5	17
4. Are you in a position to provide the committee with these data?	19	5	24	9	4	13
5. Are you in a position, to supply manufacturer's inspection reports and specifications for each digester for which you have two sets of readings or more?	19	6	25	9	3	12

It is both interesting and gratifying to the committee to note the relatively large number of companies who are using an Audigage or equivalent device in measuring digester wall thicknesses using a systematic procedure. This fact should be compared to the fact that in 1950 only two or three mills were making surveys in that fashion.

It is also gratifying to the committee to note the willingness of two thirds of the companies responding to the questionnaire to provide the committee with their respective accumulated information.

This information which has been provided is currently being used as a basis for a study by Armour Research Foundation. The results of this study will be presented at the Eighth TAPPI Engineering Conference in Montreal next October.

H. O. Teeple, *Secretary*

The Codified Patent Law of 1952

FRANK MAKARA

For many years past the patent law comprised the patent statutes or written laws and the patent case law or interpretations of the patent law. It was inevitable that some confusion would result as the years of case law increased. The Patent Act of 1952, in part, endeavors to bring the interpretive case law into uniform practice by enacting it as written statutory law, and during this codification of the practice a few procedural changes effecting the practice before the Patent Office were added.

The more important procedural Patent Office changes are: (1) papers due on a Saturday will be received on Monday, this was added to allow Washington attorneys to take Saturday off; (2) the Appeal Fee has been raised from $15.00 to $25.00, and a few other minor changes such as cost per page of photostats have also been made; (3) in the old phrase concerning patents being obtained for an "art, machine, manufacture or composition of matter" the word "art" has been replaced by the word "process."

There has been some discussion in the newspapers that the Patent Act of 1951 allows use patents. Actually use of a composition or chemical has always been patentable if defined in terms of a process for doing something. In effect, the new law merely recites what has always been the actual practice.

A change has been made in the practice involving filing in the United States after first filing abroad has been made in that now all one needs to do in nonconvention cases is to make a filing in this country before the foreign patent issues. Convention cases relate to filing in the United States the application papers within the year of the date of filing abroad to obtain as a United States filing date the same filing date obtained abroad. If one filed in the United States *after* the year's expiration from the foreign filing date, the *old* practice was that in order to obtain a valid United States patent, the United States patent must be issued before the earlier filed foreign application was issued abroad.

A practice before codification was that United States patents are good references for anticipation purposes as of their filing dates. Now this practice is written into the law.

A conception meriting a patent now must have novelty, utility, and invention. What invention is was purposely left undefined, but an obvious improvement is not invention. A combination claim having an element thereof defined in terms of "means for effecting a function" is permitted. This has always been the practice, but since the judicial decision in Halliburtion versus Walker the practice became a bit confused. Now that the means type of claim definition is recited in statutory law the confusion should be dissipated.

The old practice of prohibiting an erroneously filed patent application in the name of a sole inventor from being changed to joint inventorship is now changed so that now a filed application having one or fewer number of inventors may be charged by simply adding the name of the other inventor or inventors regardless of the fact that fewer inventors signed the original oath. An inventor who refuses to sign the application papers in a situation where another party has a proprietary interest cannot now prevent the interested party from taking out the patent in the name of the inventor.

The practice of dividing an omnibus application has been slightly changed, no longer is it called division, now it is called restriction. Also, no longer may the restricted cases be cited against one another as references. This brings Patent Office practice in line with judicial decision on this point. Review of the question of restriction is now by way of petition whereas formerly it was had by way of appeal to the Board of Appeals.

The law codifies the former practice of permitting a reissue of a patent with broadened claims if done within 2 years from the date of issue. Also reissues, if of the narrowed claims type, may now be taken out in the name of the assignee without need for obtaining the inventor's signature.

In disclaimer practice only complete claims may now be disclaimed. This is a commendable practice since partial disclaiming of a claim led to much confusion.

Misjoinder and nonjoinder of inventors may now be corrected in issued patents, as well as in pending applications (previously described).

The present codification has not erased a source of confusion as to joint owners. As the law now stands, and it is now codified, joint owners are not accountable to each other. Thus a joint owner of 5% of a patent can pocket for himself alone anything he gets by way of selling or licensing the patent without accounting in any way to his co-owner who owns 95% of the patent.

The present codified law revives the law of contributory infringement. It's purpose is to apprehend the active inducer of an infringement, i.e., the person who will not make the completed device but only some fundamental component thereof.

Lastly, false marking of "Patent pending" when in fact no patent is pending is now punishable by fine.

These are the main changes of general interest. A few changes such as those that relate to interference practice or appeal from the Patent Office to the courts have been left out as they seldom if ever occur in ordinary practice.

Frank Makara, Patent Attorney and Consulting Chemist, Massapequa, L. I.

Some Operating Characteristics of a Paper Machine Drier Section Equipped with Forced Ventilation

J. W. OREN, H. A. ROBINSON, and J. T. BERGEN

As THE title indicates, "Some Operating Characteristics of a Paper Machine Drier Section Equipped with Forced Ventilation," this paper deals only with the drier section of a paper machine and those conditions directly affecting it. Actually, the investigation of these various conditions becomes quite a sizable task as many factors are dependent upon others. Several of the factors studied during the investigation are described here but it is not possible to mention all of them in this limited discussion.

A short description of the paper machine studied is in order as both the condition of the machine and its surroundings are important in a study such as this. Figure 1 shows a plan view of no. 1 machine, no. 2 machine, and the machine room. Both no. 1 machine and no. 2 machine are housed in the same machine room, have vapor absorption air systems, panel type hoods, no drier felts, and four exhaust ducts through the roof. Four room exhaust fans are located in the roof above the middle aisle. The machines produce, for the most part, thick stock up to 50 caliper and are, therefore, quite slow moving by present-day paper standards. The word "felt" as used here refers to the heavy product of these paper machines and not the usual heavy duck drier felts.

The drying capacity, especially of no. 1 machine, has been the limiting factor regarding production rates and special efforts have been made to increase this drying capacity since 1940. These changes have followed the usual order of vapor absorption air systems, economizers, changes in condensate lines, etc. No. 1 machine is shown in Fig. 7. The vapor absorption air is supplied from two independent systems with the air at the wet end passing through an economizer as well as a heater. The drier itself consists of two decks of 48-inch drums, 34 drums in all plus a baby drum, all operating at 42 p.s.i.g. supply steam pressure. A typical placement of vapor absorption nozzles extending across the machine is shown in Fig. 2. These nozzles direct the air perpendicularly upon the felt mainly to disturb and carry away the vapors adjacent to the felt.

The need for an investigation of this sort is clearly shown on Fig. 3. This chart shows the production rate plotted on a month basis for the past ten years for no. 1 machine. From this it is seen that although in general the average production rate has been steadily rising, the variations have been becoming more and more pronounced, presumably as more and more work was done toward increasing the drying capacity. Also, although not readily apparent here, the summer-winter variation in machine speed was becoming excessive.

The variations at this point show no pattern which might suggest seasonal changes. This randomness is more apparent in Fig. 4 which shows the rate for each year by months. Various checks with plant personnel and records could not account for these variations. Hence, it was decided that there was not one, but several factors occurring at various times affecting the machine speed and that an investigation of existing conditions was in order before any further drier section changes were to be made.

The production rate of a machine such as this is, of course, partially dependent upon the moisture content of the felt supplied to it. Although not directly connected with the drying processes itself, it is possible to point out that some of the

W. OREN, H. A. ROBINSON (present address: U. S. Embassy, Paris, France), and J. T. BERGEN, Research and Development Center, Armstrong Cork Co., Lancaster, Pa.

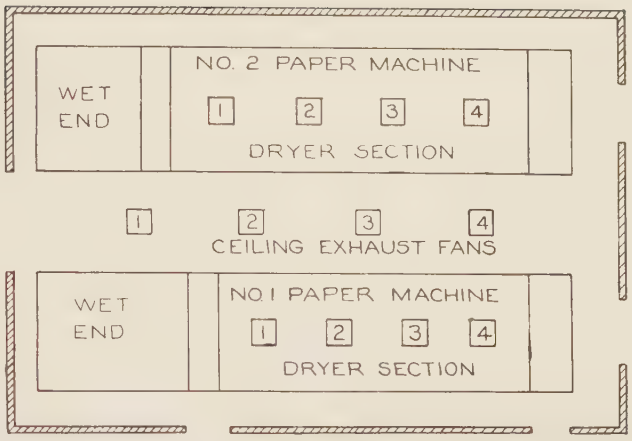


Fig. 1

variation normally attributed to the drier section might be due to the variation in the moisture content of the felt being supplied to it. Figure 5 shows a plot of per cent moisture content entering the drier section versus relative machine speed. To obtain this chart numerous plant records of moisture content were obtained for the past two years which resulted in a plot having points in a seemingly widely scattered pattern. However, by using statistical methods and taking the median of all per cent moisture contents occurring at a particular machine speed, the points shown were obtained which do show a definite trend. The importance of this is apparent when one realizes that a 5% increase in drying capacity (perhaps affected by addition of a heated air supply) is considered to be a great improvement, yet a decrease in entering moisture content from 59 to 57% will mean about an 8 or 9% decrease in weight of water to be evaporated per pound of moisture-free dry felt or conversely an increase in production of about 8%.

Referring again to Fig. 1, it was thought possible that as the two machines were in the same room the production of one might be affecting the other. Various weight felts are produced with leaving moisture contents varying from moisture-free to about 8%. Accordingly, measures of temperature and humidities were made throughout the machine room in various places during production of various weights of felt. Apparently with this type of vapor absorption air system and a hood of proper capacity, the weight of the felt has no effect upon conditions outside the hoods. Investigation of humidities under the hoods start low at the wet end, rise, and then fall approaching the dry end which is normal and to be expected.

Next, a study of the air and moisture flow under the hoods

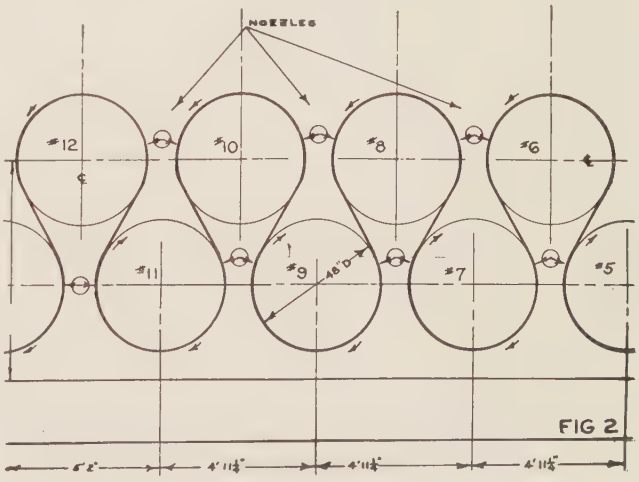


Fig. 2

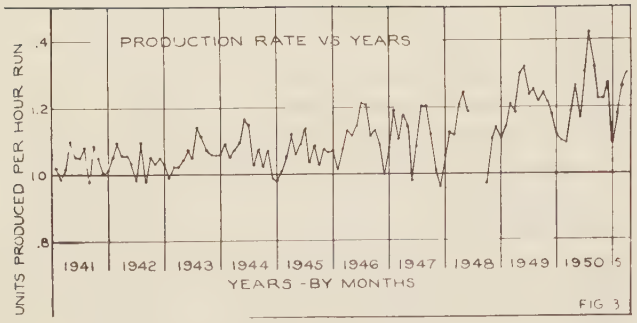


Fig. 3

themselves was made. In Fig. 6 a side view of the no. 2 machine is shown with measured air and moisture flows. The air flow out each exhaust hood is in line with designed values and fairly constant through the drier. The moisture removed is normal in that it is approximately equal in the first three exhaust hoods and low at the dry end. Figure 7 shows a similar study made of no. 1 machine. During the first part of the investigation, it was found that the first two exhaust hoods were handling volumes far below their rated capacity. Also, the bulk of the moisture (65%) was being exhausted out the dry end of the machine which meant that it had to travel under the hood over the top of the drier drums thus creating a region of high humidity over the middle section of the drier. An examination of the system showed part of the economizer on the wet end to be blocked with a greasy lint which ordinarily would not be detected unless an examination of this type was made. Upon cleaning, a second set of figures were obtained which were nearly normal as can be seen in regards to moisture flow. The volume of air flowing out the wet end is markedly improved but slightly low, probably due to the resistance in the economizer.

It is well to mention that the placement of exhaust ducts and inlets on the roof is important. The original installation on the roof of the machine room provided a vertical exhaust for no. 2 machine, a horizontal inlet for the vapor absorption system of both machines, and a horizontal exhaust of no. 1. The ducts were so placed that a west wind could do two things: (1) create a back pressure in some of the exhaust ducts and thereby decrease exhaust volume and (2) the moist exhaust air from no. 1 machine and a no. 3 machine could be picked up and blown into the vapor absorption air inlet for no. 2 machine. This duct work was changed to force all exhaust

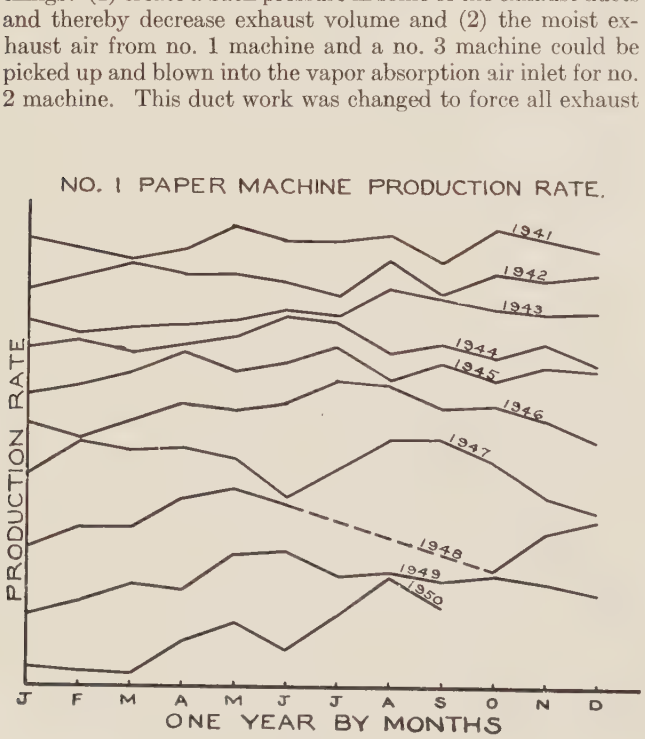


Fig. 4

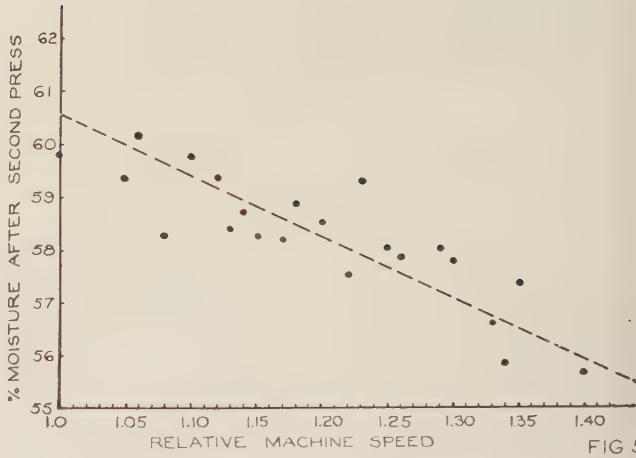


Fig. 5. Median values per cent moisture after second press vs. relative machine speed

air straight up eliminating effect of wind direction and exhausting above the intakes for the vapor absorption system on no. 2 machine.

The conditions examined thus far occur at various times and it has been very difficult to pin machine speed changes on any one thing. The following temperature studies are more concrete and actual results are apparent.

The most important single factor in fast drying rates here is undoubtedly the temperature of the felt. As mentioned previously, the felt is quite thick and it was supposed that the surfaces of the felt go through temperature fluctuations due to alternate heating of one side and then the other during the drying process. Spot temperature readings had previously been made, but it was desired to have a continuous record of temperature of the felt as it moved through the drier section. If it were possible to obtain such a trace, one condition at a time might be changed and the effect upon the temperature of the felt noted.

In order to obtain such a temperature trace, it was necessary that the temperature measuring element travel with the felt and remain in one position on it. The method used was to attach a thermocouple to the felt directly after the second press section and pass it with the required length of thermocouple wire through the drier section and record the temperature on a strip chart recording potentiometer. This apparently is an innovation in felt temperature studies and it is thought worth while to go into some detail on the procedure used.

Figure 8 shows a reconstructed thermocouple lead which was used during test and a sketch is provided in Fig. 9. A dual copper-constantan glass covered no. 24 wire was used. This wire had to be flexible enough to conform to the curvature of the drier drum and also be strong enough to withstand tension in passing through the drier section as sufficient tension was necessary to press the thermocouple against the felt at all times. Accordingly, the leading parts of the wires were

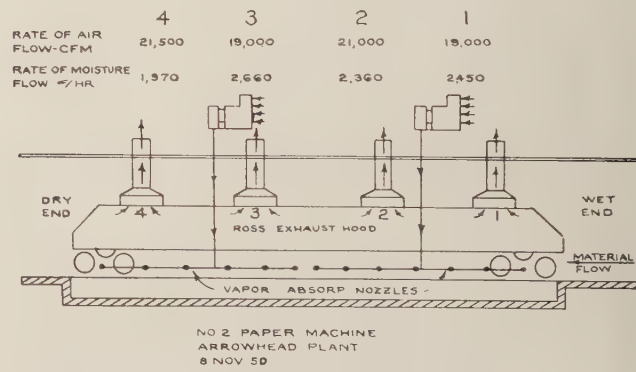
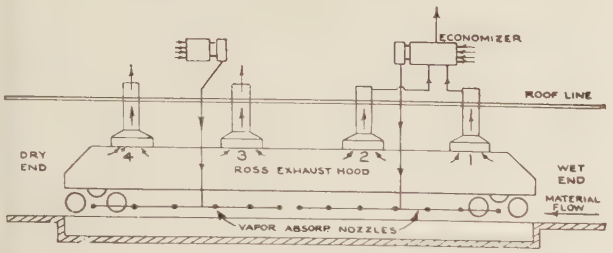


Fig. 6

	4	3	2	1
RATE OF AIR NOV 1950	31,500	26,500	9,800	8,800
FLOW - CFM JAN 1951	30,100	26,600	20,700	18,000
RATE OF MOISTURE NOV 1950	4000	4300	2600	2200
FLOW #/HR JAN 1951	3120	4280	4380	2500



NO. 1 PAPER MACHINE
ARROWHEAD PLANT
NOV 1950 AND JAN 1951

Fig. 7

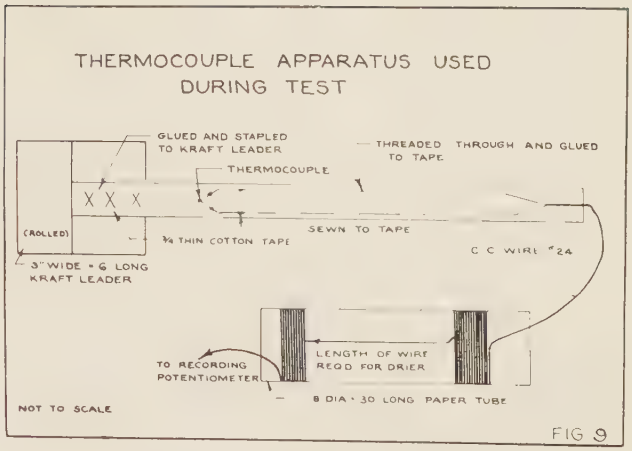

THERMOCOUPLE APPARATUS USED DURING TEST
GLUED AND STAPLED TO KRAFT LEADER
THREADED THROUGH AND GLUED TO TAPE
THERMOCOUPLE
X X X
(ROLLED)
SEWN TO TAPE
¾ THIN COTTON TAPE
C C WIRE #24
3" WIDE - 6 LONG KRAFT LEADER
TO RECORDING POTENTIOMETER
LENGTH OF WIRE REQD FOR DRIER
8 DIA - 30 LONG PAPER TUBE
NOT TO SCALE
FIG 9

Fig. 9

ided to a relatively small diameter to reduce the stiffness and the mass of metal. The dual wire was separated for about 12 inches and each wire threaded through one end of a $^3/_4$-inch le very loosely woven thin cotton tape. The wire was then urely attached to the tape by pasting cloth on both sides. The 3 or 4-inch ends of the wire were crossed once, soldered to m the thermocouple, and sewn to the tape. A 600 to 700-ot spool of trailing thermocouple wire (sufficient length to tend through the drier section) was then meticulously iled onto an 8-inch diameter cardboard tube in such a way as to give one twist of the wire per turn onto the tube. By slipping the wire off one end of the tube (the same idea as used in the "spinning" fishing reels) when feeding the wire through the drier, the use of slip rings was avoided inasmuch as a rotating member was eliminated and the "twist" untwisted leaving a straight wire. The wire on the other end of the tube was connected to a cold junction and a strip chart recording potentiometer, 0–5 millivolts full scale, chart speed of 1 inch per 10 seconds.

The felt, in traveling through the drier section, has one surface exposed to the air while passing over the top drier drums and the other side exposed to the air while passing over the bottom drums. This is an alternate condition occurring through the entire length of drier section as can be seen by tracing the path of the felt in Fig. 2. This thermocouple is used only to measure the surface temperature of the felt; thus as there are two possible positions in which to pass the thermocouple through the drier, the traces are designated at either "between felt and drum on upper row" or "between felt and drum on lower row."

In making a test, all equipment was set up at the wet end of the machine. The operator then coated the kraft leader with sodium silicate and pressed it against the wet felt which was traveling over his head. The leader then pulled the wire after

Fig. 8

it and at this time, tension was placed on the wire to insure a tight pressing of the thermocouple against the felt. The wire was then pulled off one end of the magazine roll until the thermocouple reached the dry end when the wires were clipped.

The actual tests were of short duration (about 3 to 5 minutes) but the coiling of the wire consumed considerable time which proved to be the limiting factor in the number of tests to be made. Figure 10 shows a typical temperature curve through machine no. 1. In the electrical setup used in the tests no means were readily available to accurately mark the chart for correlation between position of thermocouple in the drier section and the recording pen during test. By comparing machine speed, chart speed, and calculated lengths of felt in the drier, the vertical lines were located to indicate position, as, for example, L20 means leaving drier roll no. 20; thus, in the temperature trace shown the thermocouple enters at about 85°F., is pressed onto the wet felt at the baby drier and leaves, whereupon the felt temperature begins to fall. As the chart is moving at a constant speed, we obtain a plot of temperature versus time (which can be converted to machine position). In passing over successive drums the felt temperature increases until a temperature slightly below the boiling point is reached, somewhere around the 8th drier drum. Temperature variation of the surface of the felt then continues to the dry end. A more detailed explanation of the temperature changes will follow with discussion of the various charts.

One of the main items to be investigated was the effect of vapor absorption air temperature upon felt temperature. Two separate tests were made, one at the ordinary vapor absorption air temperature and one at a higher temperature. The resulting temperature traces are shown on Figs. 10 and 11, respectively. The temperature trace at the lower vapor absorption temperature (180°F. wet end and 178° dry end) shows that the average temperature of the felt on this day was highest between the 8th and 18th driers and then fell off possibly 10° as it approached the dry end. The average temperature of the felt at the dry end was about 188° and about 198° at the wet end, being 10 and 20°, respectively, above the vapor absorption supply air temperature. Thus, in effect, the vapor absorption air is carrying away vapor and at the same

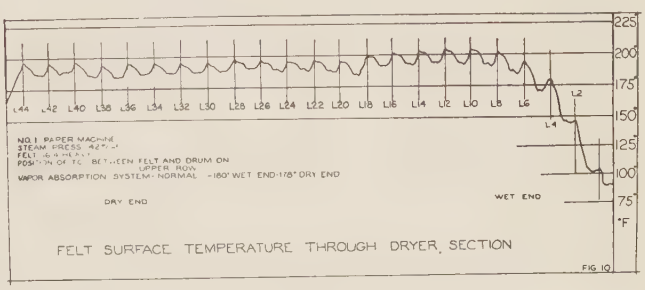


Fig. 10

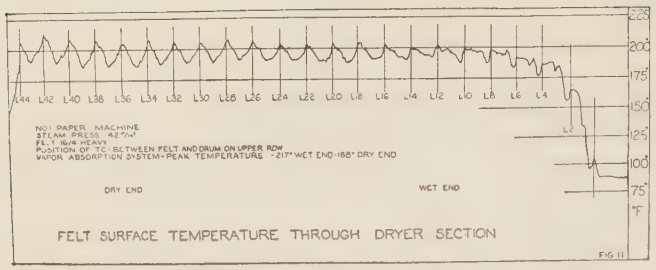

NO. 1 PAPER MACHINE
STEAM PRESS. 42 #/in²
FELT 16/4 HEAVY
POSITION OF TC - BETWEEN FELT AND DRUM ON UPPER ROW
VAPOR ABSORPTION SYSTEM - PEAK TEMPERATURES - 217° WET END - 188° DRY END
DRY END
WET END
FELT SURFACE TEMPERATURE THROUGH DRYER SECTION
FIG 11

Fig. 11

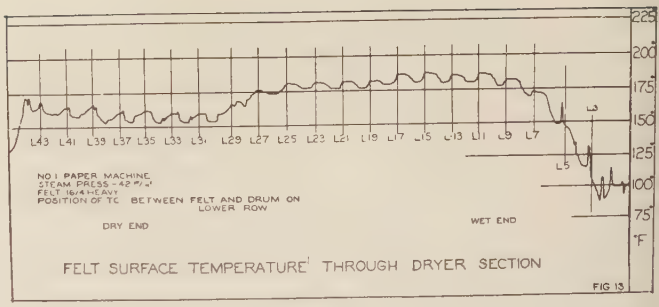

NO. 1 PAPER MACHINE
STEAM PRESS - 42 #/in²
FELT 16/4 HEAVY
POSITION OF TC BETWEEN FELT AND DRUM ON LOWER ROW
DRY END
WET END
FELT SURFACE TEMPERATURE THROUGH DRYER SECTION
FIG 13

Fig. 13

time cooling the sheet due to the temperature differential as well as evaporation. The temperature at the wet end is presumably higher because the sheet, being wet, has a greater conductivity than when it is dry and the heat from the drier drum is able to overcome the cooling effect of the vapor absorption air and that due to evaporation.

This same test was repeated by having the vapor absorption temperature systems at their peak resulting in a wet end temperature of 217°F. and a dry end temperature of 188°F., the wet end air temperature being higher due to the presence of the economizer. The general trend of this curve is different from the previous one in that there is a gradual rise in temperature toward the dry end although the temperature of the vapor absorption at the wet end has been raised much more than the dry end. At the wet end the sheet is thoroughly wet and evaporation takes place at a constant rate at a temperature slightly below the boiling point (due to the cooling effect of evaporation) and that raising the dry bulb temperature has probably increased the saturation pressure of the air enough to increase the rate of drying, the increased evaporation keeping the sheet about the same temperature. From all indications of the tests, the wet bulb temperature is not exceeded until the outer layers are partially dry. The average temperature at the dry end, however, has increased, being about 10° above the previous temperature trace, which is about equal to the rise in vapor absorption air temperature. Thus, raising the vapor absorption temperature has been shown to produce a higher average felt temperature through the machines and should increase the drying capacity appreciably.

Figure 12 shows two temperature traces taken on another machine in the same plant. This machine is not as large as the two previously described, has a hood-type exhaust system, and is equipped with drier felts. These felts, of course, provide better contact between the felt and drier surface, and the temperature traces here will give a comparison of felt temperatures against those obtained without drier felts. We see here due to the drying felts (the steam supply pressures are the same as in the other machine) the average felt temperature is much higher, being around 200°F. There is shown on this chart two traces, one between the felt and drum on the upper row and one between the felt and the drum on the lower row. The exact positioning of one curve upon the other is open to question because no marking means were available as mentioned before. To give a detailed explanation of the curves is beyond the scope of this paper but it can be done as will be shown later.

Thus, it is shown that the drier felts, even on the relatively thick felt, produce a higher and more consistent felt temperature and are more effective than the vapor absorption system in raising felt temperatures.

Another temperature trace of no. 1 machine is shown in Fig. 13. This trace is seen to be radically different from the previous figures. The original intention was to provide a companion trace to Fig. 10, this trace showing the temperature on the other side of the felt. In order to obtain a trace between the felt and the drier drum on the lower row, the leader must be attached to the top side of the felt after the press section which is a rather difficult job due to the mechanical setup of no. 1 machine. The first attempt resulted in a partially torn sheet. The kraft leader, however, was not completely destroyed and a second attempt was made about a minute or two later which provided the trace shown in Fig. 13. At first glance the trace seems to be in error as the average temperature was below any of the previous charts and it was thought that the thermocouple might have been improperly placed upon the felt. Examination showed that the leader was properly attached and the couple had been pressing against the surface. Examination of a chart from a moisture meter giving the per cent moisture of the felt leaving the drier section showed that during this period the moisture content had at one time risen above 12%. It was decided that due to the partial tear in the sheet, some of the sheet tension had been lost and some time had been required to regain the original tension. The loss of sheet tension prevented good contact between the felt and the surface of the drier drum which reduced the heat conduction rate and produced a wetter felt at the dry end. The lowered temperatures shown here are, therefore, due to poor contact resulting in a lower rate of heat transfer.

Here again the wet end temperatures were higher apparently because the conductivity of the felt is higher at the wet end than at the dry end.

The previous description discussed only general effects of changes of conditions and we have only spoken in terms of average temperatures throughout the drier. In some of the better traces it is possible to analyze the various changes.

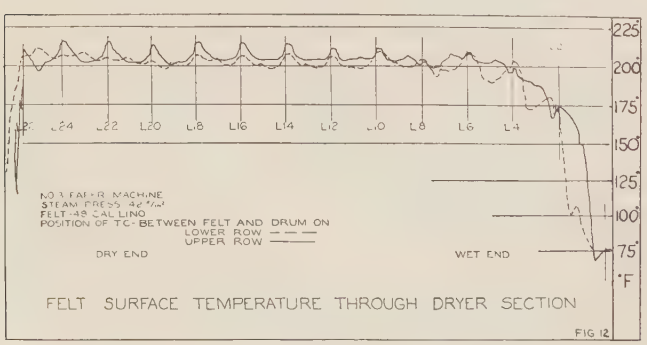


Fig. 12

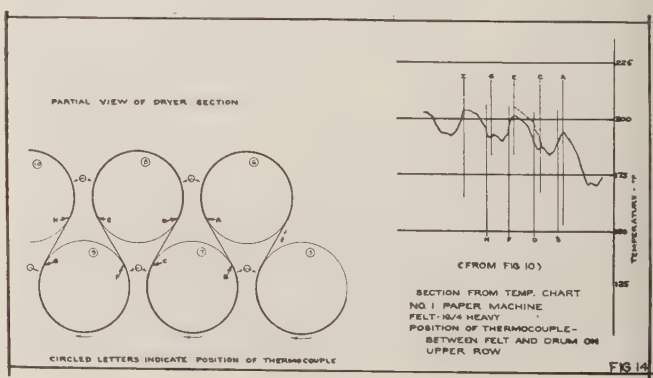

PARTIAL VIEW OF DRYER SECTION
CIRCLED LETTERS INDICATE POSITION OF THERMOCOUPLE
(FROM FIG 10)
SECTION FROM TEMP. CHART
NO. 1 PAPER MACHINE
FELT - 16/4 HEAVY
POSITION OF THERMOCOUPLE - BETWEEN FELT AND DRUM ON UPPER ROW
FIG 14

Fig. 14

Figure 14 contains a portion of Fig. 10 and in addition a corresponding view of the drier section. The following seems to be a logical explanation of the various pips and humps along the curve. Starting at A, the temperature of the felt begins to drop as soon as it leaves the surface of drier drum 6. The temperature continues to fall due to the cooling effect of the surroundings and evaporation until halfway around 7 when heat conduction through the sheet from the hot side overcomes the cooling effect and the temperature begins to rise again. A cooling starts slightly before C due to the vapor absorption air jet. In this particular case the vapor absorption supply temperature was about 180° and the felt was about 188° as indicated by the chart. The jets undoubtedly aid evaporation at this point by breaking up the vapor barrier at the surface of the felt but do cool it also due to the temperature differential. The temperature is seen to rise before touching drier 8 at point D. It is thought that this rise in temperature is due to the back side of the felt being much hotter (surface temperature of the drum being about 270) after having been in contact with the drum and heat conduction through the sheet overcomes the cooling on the thermocouple side and hence a small rise in temperature follows. It is possible that if a jet were supplying air say at 240°F., the temperature curve would follow a path as is shown dotted resulting in an earlier rise in temperature.

From this investigation, we see that any one of a dozen conditions, either apparent or hidden, can effect the drying rate a great deal. In dealing with systems of forced ventilation such as this, great care should be taken in placement of duct work and periodic checks should be made to insure proper air flows. If these systems are designed and working properly, any number of machines may be placed in close proximity without affecting one another.

The felt temperatures as presented here do give a good idea of the complicated drying process in a drier such as this. Some error might be present due to the insulating effect of the cotton tape or the large conductivity of the thermocouple wire but these are undoubtedly small when compared with the variations involved. It has been shown that a relatively small increase in vapor absorption temperature materially increases the felt temperature and that the vapor absorption system should be run at as high a temperature as is economically feasible.

National Council for Stream Improvement

OREGON STATE COLLEGE, BATES COLLEGE

Waste Sulphite Liquor

The investigation of the heat hydrolysis treatment for waste sulphite liquor was terminated during the year. The progress of the investigation, in spite of original optimistic indications, revealed inherent difficulties. The corrosive nature of the sulphite liquor required stabilized stainless steel equipment. The residence requirement of the liquor at effective high temperatures and pressures for a minimum of 1 hr. necessitated large capacity high pressure equipment. Heat requirements were high and approximated those of evaporation. Economy of processing could only result from efficient heat exchange which would have to be accomplished under unfavorable conditions of corrosion and tube scaling and the heat provided would have to be at a high temperature level requiring very high steam pressure or auxiliary high temperature heating, such as with Dowtherm or equivalent. To overcome the apparent difficulties, such procedures were involved as rapid liquor circulation with attendant pump difficulties and foaming, high pressure heat exchangers in multiple to facilitate cleaning and flash discharge with heat recovery. Calculations revealed that should the foregoing problems be overcome, the heat requirements for the heat hydrolysis treatment of waste sulphite liquor would almost equal those required in a multiple effect evaporation system. In addition, the heat for the hydrolysis treatment would have to be at a high temperature level as compared to the evaporation heat requirement. In addition, the evaporation and burning would approach 100% B.O.D. reduction, while the best that could be expected from heat hydrolysis would be 60% B.O.D. reduction.

Since the termination of the heat hydrolysis investigations an exploratory program has again been initiated and a number of procedures are being investigated for the treatment and disposal of waste sulphite liquor in algae cultivation and garbage composting. These investigations are under the direction of Dean G. W. Gleeson, School of Engineering and Industrial Arts, Oregon State College.

The Bates College project, under the direction of Walter A. Lawrance, Head of the Department of Chemistry, has continued the investigation of the reactions of waste sulphite liquor in streams. The results of this investigation have shown that there is no evidence of hydrogen sulphide production in stream and benthal deposit samples when nitrates are present and that stream water may be stabilized effectively by the addition of nitrate oxygen in quantities slightly in excess of the 5-day, 20°C. B.O.D. Studies of river waters showed that phosphates are readily removed by flocculation. Analyses of river waters and benthal deposits indicate that the phosphates in river waters are probably removed by adsorption on suspended and colloidal particles and accumulate in the benthal deposits.

LOUISIANA STATE UNIVERSITY

Kraft Mill Wastes

The most significant development of the kraft mill wastes project has been the design and operation of the cooperative waste treatment pilot plant of the southern kraft manufacturers at Macon Kraft Co. in Macon, Ga. After a period of more than 1 yr. the pilot-plant operation was terminated in October, 1952.

The operating results have shown that it is possible to consistently obtain treated effluents with appreciable reductions in B.O.D. The process is capable of treating selected individual or mixed kraft mill effluents normally discharged in the kraft manufacturing process and the treated effluents are free from appreciable odor, from substances potentially toxic to aquatic life and lower in color than the untreated waste. Wastes with temperatures up to 50°C. can be treated with no decrease in efficiency. Successful application of the process depends upon the efficiency of the mill recovery system and the control measures taken to equalize the strength of the waste discharged to the treatment unit. Major operating costs stem from the supplementation of the kraft waste with the required nitrogen salts and compressed air for the aeration. Construction costs are a major consideration due to the size and quality of the structures and equipment required.

Kraft mill waste treated by this method, when added to larger volumes of untreated waste, greatly stimulates its oxidation upon storage, thereby reducing the detention period required to stabilize the ponded waste. Storage periods for over-all B.O.D. reductions of 60% have been decreased from 12 to 20 days to 3 to 5 days. In this manner, treatment of a portion of the mill effluent by the aeration method prior to lagooning the entire waste will make storage oxidation more effective.

In view of the economic considerations it is anticipated that the major application of this type of treatment will be to augment the storage oxidation treatment method for kraft mill effluents, as described above. It is probable, however, that the aeration method alone will find application where storage oxidation may not be feasible for various reasons. The successful development of the aeration process also serves

This report covers the research and development activities of the National Council for Stream Improvement for 1952. It was proposed by the staff of the Council.

to make available new mill sites which had previously been considered unsuitable from a stream pollution standpoint.

At the present time the aeration type of treatment, in conjunction with storage oxidation, is being applied on a large-scale basis at a member kraft mill in the southern region. The waste treatment plant in operation there is capable of treating 1000 g.p.m. of pulp mill effluent. Designs are being prepared for similar large-scale treatment plants at several other southern kraft mills.

Laboratory work on the problem of color removal from kraft mill wastes has proceeded rapidly. The results of a one-stage lime treatment process indicated the impracticability of this method. The method involved the addition of hydrated lime to the waste followed by carbonation to a predetermined point, settling, dewatering of the sludge, and finally, calcining of the sludge. The one-stage treatment proved unsatisfactory for several reasons. Lime losses are relatively high, even after carbonation, if maximum color removals are to be attained. Lime losses can be decreased to some degree only at the expense of color removal efficiency. At a point of compromise between lime loss and color removal the lime losses ranged from 1.7 to 2.5 lb. of calcium oxide per 1000 gal. of waste treated, while color removals ranged between 70 and 80%. Control of the optimum degree of carbonation is extremely difficult and no simple control procedure has yet been developed. Among the control methods investigated were pH, alkalinity, and soluble calcium determinations. Variability of the optimum point of carbonation was found to be influenced by the original pH of the waste, the adjusted pH of the waste, the initial color, and the lime dosage used in the treatment.

As a consequence of the difficulties encountered in the one-stage lime treatment process for color removal the emphasis has been shifted to a multiple-stage treatment process. This process consists of the addition of hydrated lime to the waste followed by settling and the separation of the sludge. The dissolved lime in the supernatant is recovered by carbonation and sedimentation and recovered by calcining. In all probability, the major problem in the multiple-stage treatment process is the recovery of the line in the first sludge which results from the addition of hydrated lime to the waste. This sludge is voluminous and gelatinous in character and does not lend itself readily to dewatering by presently available equipment generally used for this purpose. Calcining of this sludge, which is high in organic matter content, also presents difficulties.

Presently under study is a promising method of treating this calcium-organic sludge, permitting the recovery of the lime in the form of the carbonate which can readily be calcined in present lime kiln installations at kraft mills. The method involves the addition of sodium carbonate or green liquor to the sludge resulting in the complete precipitation of lime as the carbonate. The resulting supernatant liquor is evaporated in order to recover its soda content. The process envisions the use of existing kraft mill chemical recovery systems. Several variations are possible, including the use of sodium hydroxide or white liquor for the treatment of the sludge. If these projected treatments prove feasible the problem of dewatering the calcium-organic sludge is eliminated. It will be necessary, however, to develop a technique for increasing the solids content of the calcium-organic sludges in order to minimize the costs involved in the recovery of the soda content in the resulting supernatants. All of these various modifications will be investigated fully.

The kraft mill wastes project is under the supervision of William A. Moggio, National Council Resident Engineer for the Southern Region.

VIRGINIA POLYTECHNIC INSTITUTE

Semichemical Wastes

The semikraft and neutral semisulphite processes appear to be the methods of choice in the manufacture of semichemical pulps. Now that the manufacturing process has resolved itself, the matter of semichemical waste treatment or disposal becomes enmeshed with the competitive aspects of the manufacturing process. A goodly portion of the favorable competitive position enjoyed by semichemical pulps results from the economies in manufacture. Expenditures made for rendering semichemical wastes innocuous must be added to the manufacturing costs thereby lessening the economic advantages of the process. This consideration is one of several factors involved in the present interest among semichemical manufacturers in the development of an economical chemical recovery system. These considerations are not involved when semichemical pulping is integrated with kraft production since the spent chemicals can be recovered by incorporation into the kraft chemical recovery system and reused in the kraft pulping process. Among the benefits resulting from an economical recovery system would be the great reduction in B.O.D. and color of semichemical waste discharges as they now occur from nonkraft integrated mills.

Due to the chemical, physical, and pollutional characteristics of the semichemical wastes of today it appears unlikely that any presently known waste treatment process can be applied with any reasonable degree of economical and practical success. Investigations in the realm of waste treatment are being continued and at the same time the efforts of the project are also being directed toward certain phases of the chemical recovery process development.

Investigations were made on submerged combustion of semichemical waste liquors as a possible means of waste concentration. The results indicated that the operating costs of this method of concentration compare unfavorably with multiple effect evaporation although costs for the initial installation were lower. Submerged combustion has some minor advantages over multiple effect evaporation and it may prove feasible under certain conditions or at certain mills.

Selective solvent concentration, utilizing organic solvents capable of absorbing water away from the waste solids, also compared unfavorably to multiple effect evaporation from an operating cost standpoint. Acetone was found to be the most effective solvent investigated to date. It appears that in order for this method to compete favorably with multiple effect evaporation it will be necessary to find a highly selective and efficient solvent. Closely associated with the investigations of semichemical liquor concentration are preliminary studies of methods for the recovery of the acetate content from the concentrated liquor.

Heat hydrolysis studies, similar to those made on waste sulphite liquors, have not yielded promising results. The high temperatures and pressures employed do not cause the destructive hydrolysis of wood sugars and the oxidation of acetates. The major B.O.D. contributor in semichemical waste liquor, the acetate radical, is extremely resistant to this type of chemical destruction while the sugars break down in a stepwise manner only after prolonged and extreme treatment. The maximum B.O.D. reduction attainable by this method of 40 to 50% is attained only at an unreasonably large cost.

In anticipation of the time when a suitable chemical recovery system is developed for the semichemical process, biological oxidation of weaker semichemical liquors has been explored. Previous work on biological oxidation of semichemical liquors involved the use of the concentrated wastes with very poor results. Considerable success was experienced, however, when more dilute wastes are treated biologically. Utilizing the same procedure developed for the biological treatment of kraft wastes it has been possible to obtain as much as 80% B.O.D. removal using semichemical wastes with an initial strength of 400 p.p.m. B.O.D. and 70% B.O.D. removal with wastes of 1000 p.p.m. B.O.D. It is apparent then that the treatment of residual wastes from semichemical pulping operations which include chemical recovery will present no major problem.

The future program for the semichemical waste project will include the continued investigation of waste concentration methods and the search for an efficient dewatering solvent, continued development of the biological oxidation treatment of dilute residual wastes, development and evaluation of acetate recovery methods, a study and evaluation of pulp washing methods and the continued search for a satisfactory and economical waste treatment method. The semichemical waste project is under the direction of Robert E. Opferkuch, Jr., the Council's Resident Engineer in the South Central Region.

RUTGERS UNIVERSITY

White Water and Rag, Rope, and Jute Wastes

Laboratory studies were made of the oxidation and stabilization of cellulose sludges under aerobic and partially anaerobic or benthal conditions. Results of the studies show that the oxidation of cellulose sludge is similar in character to that of sewage sludge but that the rate of anaerobic decomposition of cellulose sludge under benthal conditions is less than in the case of sewage sludges. The rate of aerobic oxidation of cellulose sludge is approximately the same as for sewage sludge except that the amount of oxygen demand is almost 100% of the volatile solids whereas it is only 70% of the volatile solids for sewage sludge. For benthal decomposition the amount of oxygen demand for cellulose sludge is about equal to that for sewage sludge on a volatile solids basis. The degree of stabilization, however, is less than for sewage sludge because of the inhibition by the methane produced due to acidic conditions. When cellulose sludge is mixed with a large proportion of digested sewage sludge or with limestone the benthal oxidation rates are doubled. Anaerobic stabilization and gas production are significantly increased with digested sludge seeding but only slightly increased with limestone addition.

Investigations are being made of the aerobic decomposition of cellulose fiber. It has been found that the oxidation of cellulose by microbiological cultures developed from sewage proceeds approximately twice as fast at pH 7.0 than at pH 5.5 to 6.0. The addition of yeast extract in quantities equal to 0.1% by weight of the cellulose causes an additional 25% increase in the oxidation rate. When using yeast extract with developed cellulose-oxidizing seed, 70% decomposition of the cellulose is achieved in 5 days and complete oxidation in 13 days, an increase of 100% in the oxidation rate. Further investigations of the factors influencing cellulose decomposition and the possible use of pure cultures of cellulose decomposing organisms are in progress.

Filtration characteristic studies of tissue white water and sludges are also being made using pressure filtration and diatomaceous filter aids. Optimum quantities of filter aid at maximum pressure and filtration rate are being investigated initially. Using filter aid precoat alone the total amount of filtrate produced increased with increasing amounts of precoat. The optimum quantity of diatomaceous earth precoat was determined to be 7 oz. per sq. ft. of filter area. When filter aids are added continuously with optimum filter precoats it was found that in order to obtain any additional benefit over filter aid precoats alone it is necessary to use quantities of filter aids equal to at least 50% by weight of the suspended solids content of the sludges being filtered. Filtration rate increases uniformly with filter aid additions in amounts up to 30% by weight of the suspended solids content of the sludges being filtered, beyond which no further advantage results. The pressure filtration studies will be continued to determine the effect of lime and heat in conjunction with the use of filter aids.

Reports have been prepared and distributed during the year on various phases of the biological and chemical treatment of rag, rope, and jute wastes. Results of the laboratory investigations have indicated that the aerobic biological treatment methods show some promise, in particular, the dispersed growth aeration treatment. Also under study at one mill is a method of oxidation lagooning while trickling filter treatment is being studied at another mill.

The white water and rag, rope, and jute wastes studies were made under the direction of Willem Rudolfs, Chairman, Department of Sanitation, Rutgers University.

UNIVERSITY OF MICHIGAN

Stream Analysis

The National Council has continued to utilize the services of the stream analysis project to define the natural purification characteristics of streams on which pulp and paper mills are located and to forecast stream conditions expected under various hydrologic regimes and pollution loads. For a specific river problem, stream analyses are developed from detailed information as to quantity and character of pollution, physical, hydrologic, and hydraulic characteristics of the stream, and, for purposes of verification of the natural purification factors adopted, reliable water course sampling. Where essential basic data are not available field surveys are carefully planned and executed by the Council's staff in cooperation with the mills or regulatory agencies involved. Usually it is necessary to design a short but intensive water course sampling program in order to reliably reflect existing stream conditions under a known pollution loading at a steady hydrologic regime. To this end, long-term forecasts of the United States Weather Bureau and current stream discharge measurements by the United States Geological Survey are proving invaluable in design of the sampling schedule.

One approach to the problem of stream improvement which researchers of this project have pointed up is correlation of the waste discharge with variation in stream flow taking advantage of the increased self-purification capacity during seasons of high runoff. Rational decisions concerning approach to stream improvement in any specific basin are primarily dependent upon quantitative definition of the self-purification capacities, to permit fullest utilization of water resources without waste or abuse.

Among studies completed during the past year is a comprehensive report on improvements observed in Everett Harbor, Wash., through installation of a deep submerged dispersal system. Through extensive statistical analyses of observations made before and after operation of the deep dispersal works the improvements within this complex tidal estuary were quantitatively defined. The researches also developed new basic knowledge concerning natural purification with disposal in deep tidal waters.

A major study was completed for Savannah Harbor, Ga. The study evaluated the influence of natural drought runoff and improvements to be expected in the tidal reach from completion of upland storage developments now under construction. In addition, the researches dealt with the complex phenomenon of sea water intrusion and developed analytical means for quantitative determination of dissolved oxygen contribution of this valuable asset to the brackish reaches of the harbor.

A continuing function of the stream analysis research project is pollution prevention through advisory service by the Council to its membership on new mill locations, expansions, or modifications in process. Such researches deal not only with facts concerning water resources and existing development, but equally important, are concerned with the future industrial potentials and proposed river developments as they relate to pollution.

Presently under investigation is the James River, including the upper tributary, the Jackson, and the tidal reaches below Richmond, Va. The stream analysis research is carried out at the School of Public Health, University of Michigan, under

the direction of Professor Clarence J. Velz, Chairman, Department of Public Health Statistics.

KALAMAZOO COLLEGE

Deinking Mill Waste

The activities of this project were confined to development work which followed laboratory and pilot-plant investigations of previous years. A comprehensive report of the operation of the demonstration deinking waste treatment plant of the Kalamazoo River Improvement Co., which was designed by and operated under the supervision of National Council engineers, was prepared for distribution during the year. Following preparation of this report the work of this project consisted mainly of the application of data and experience gained in the demonstration plant operation and in the operation of full-scale treatment plants in Fitchburg, Mass.

Project personnel assisted in the design of three full-scale deinking waste treatment plants. One of these plants was placed in operation in October, 1952, at the Bergstrom Paper Co., Neenah, Wis. Two others are currently under construction in Kalamazoo. All are primary treatment plants.

Plans for several other deinking waste treatment plants in the Kalamazoo area are currently being prepared. Included therein is the conversion to primary treatment of the aeration unit of the demonstration plant, now owned by the Michigan Paper Co. of Plainwell.

Close cooperation and liaison are maintained by Council personnel in this area with the deinking waste sludge utilization project at Western Michigan College. The latter project was established by the Kalamazoo River Improvement Co. for the purpose of investigating the utilization of sludge discharged from deinking waste treatment plants. The project is partially financed by the National Council.

The Kalamazoo College project is under the direction of Anthony J. Palladino, National Council Resident Engineer for the Central and Lake States Region.

PURDUE UNIVERSITY

Strawboard Wastes

Studies of strawboard wastes during 1952 have been on the effects of nitrogen additions during anaerobic digestion and attempts to increase activity in the anaerobic decomposition of strawboard sludge.

Anaerobic studies in the laboratory and pilot plant indicated that removals of polluting material may be obtained by this method of treatment. The rates of anaerobic decomposition obtainable, however, were so low that it was considered impractical to build structures large enough to treat the wastes. In addition, in order to obtain consistent results, it has been found necessary to maintain the temperature of the waste in the treatment process at approximately the discharge temperature of the raw waste. On large-scale waste treatment installations this would prove difficult and expensive.

In an attempt to increase the rate of decomposition during anaerobic digestion, which would result in the reduction in size of structures needed to carry out this method of treatment, studies have been made on the supplementation of the waste with nitrogen compounds. The importance of available nitrogen in the anaerobic process has been pointed out by many investigators and there is evidence that strawboard wastes do not contain sufficient nitrogen to maintain maximum rates of decomposition. The data obtained from this study indicate that no appreciable increase in the rate of decomposition is obtained by nitrogen supplementation. It is possible, however, that these studies were not directed toward the development of a more concentrated biological flora in the experimental digestion units. This may explain the lack of success in obtaining increased rates of decomposition in spite of the nitrogen additions.

With this in mind studies are under way to determine whether the activity in anaerobic digestion tanks or lagoons can be increased by increasing the concentration of the solids being treated in the digestion tank. Concentration of the solids in the waste to be treated results, in effect, in an increase in the biological flora per unit volume of waste to be treated. Concentration of the solids per unit volume would also result in decreasing the size of the structures in the treatment plant which would be desirable from a standpoint of economy. Nitrogen supplementation will also be investigated further in connection with the increased solids concentration studies.

The strawboard waste project is under the direction of Don E. Bloodgood, Civil Engineering and Engineering Mechanics Department, Purdue University.

INSTITUTE OF PAPER CHEMISTRY, OREGON STATE COLLEGE

Aquatic Biology

The aquatic biology project at The Institute of Paper Chemistry under the direction of Willis M. Van Horn, Research Associate, has been concerned with studies to determine the lower oxygen tolerance of various species of "warm water" fish. Using aquaria especially designed for maintaining water at any desired dissolved oxygen concentration and temperature, several species of minnows and one species of crayfish were tested. It was found that fish could survive a lower oxygen concentration if permitted time to acclimatize themselves rather than being suddenly placed in water having low oxygen content. By gradual acclimatization it was found that minnows could live for at least 5 days, without apparent ill effects, in water containing as little as 0.7 p.p.m. dissolved oxygen. Crayfish survived oxygen concentrations of 0.2 p.p.m. These experiments were made at a temperature of 12°C. and a pH of 7.2. This work will be continued using more fish species and at varying temperatures and pH values.

The aquatic biology project at Oregon State College, under the direction of R. E. Dimick, Head of the Fish and Game Management Department, was directed toward the investigation of avoidance and escape actions of salmonoid fishes in relation to kraft mill effluents and the effects of low dissolved oxygen tensions on young chinook and silver salmon. Previous studies involving bioassays employing a simulated stream were also continued. In the avoidance and escape investigations kraft mill effluent dilutions were used ranging from 1 to 13.5% by volume, in a specially designed trough. The young salmon appeared to prefer the channels receiving slightly darker water, resulting from 1 to 3% dilutions, over channels receiving clear, colorless water.

The dissolved oxygen tension studies were made in continuous samples of running water having constant levels of dissolved oxygen and water temperature for periods of time up to 13 days. The dissolved oxygen levels ranged from 1.8 to 8 p.p.m. and temperatures from 6.5 to 32.2°C. Observations made showed that juvenile chinook and silver salmon are capable of living, without apparent discomfort, for at least 5 days at 3 p.p.m. dissolved oxygen at 20°C. It was also noted that young chinook salmon can live without apparent harm or discomfort at 2.5 p.p.m. dissolved oxygen and 17.3°C. for at least 4 days, and that young silver salmon displayed no mortalities at 2 p.p.m. dissolved oxygen and 20°C.

In the simulated stream studies a 60-day test having a continuous flow of 1 to 20 dilution of kraft mill effluent did not result in any mortalities of the chinook and silver salmon test fishes. These results corroborate observations made in other parts of the country. In the Northwest, all kraft mill effluents receive considerably greater dilution than 1 to 20. Examination of the condition of the bottom material in the simulated stream revealed no hardening of the gravel, sand, and silt over a 3-mo. period of testing.

Recent Advances in Pulping Straw in the United States

S. I. ARONOVSKY

In order to evaluate the progress of straw pulping in the United States in recent years, it is desirable to describe the technological and economic conditions which prevailed prior to these newer developments. A brief historical résumé is given of the use of straw by the American paper and board industries up to about 1940 when definite changes in straw procurement practices and in the technology of the production of straw pulp began. The improvement of these conditions, aided by the work of the Northern Regional Research Laboratory whose program on the industrial utilization of agricultural residues was established at about the same time, is discussed. In addition to its work on improving the quality of strawboard pulp, the Northern Regional Laboratory has also carried on research on the development of pulps from straw and other agricultural residues suitable for the better grades of unbleached and for fine bleached papers and boards. The newer pulping processes resulting from this work have been instrumental in creating the present high degree of interest of the American pulp and paper industry in the use of straw as a supplemental raw material.

EARLY HISTORY

The cereal grain straws were probably the first raw plant material to be pulped directly for the manufacture of paper and board in the United States. The straw pulps produced were blended with rags and other waste fibers to manufacture many different grades of paper and boards to supply the requirements of this growing country. The first process developed in the United States for pulping the whole straw was patented by William MacGaw, Meadville, Pa., May 22, 1828, but a commercial trial of this process in New York State was not successful. The first successful production of a paper product from straw took place at the George A. Shyrock mill, Chambersburg, Pa., in 1831. This mill manufactured binder board on a cylinder machine, with a production capacity of 300 lb. per hr. The first pulp mill to produce a bleached raw product was erected at Rensselaer, N. Y., by John B. Pavis, who reportedly used the first steam-heated driers.

Bleached straw pulp was used for newsprint and higher grade papers. Unbleached straw paper was widely used for wrapping meats and was not displaced as butcher paper until the early part of this century. For the stronger types of paper the straw pulps were mixed with pulps made from rags, rope, or bagging. The straw wrapping paper was the forerunner of the paper bag; the stiff paper was formed into a tube which was closed, after filling, by folding over the top edges.

Straw, rags, and the other available waste fibrous products continued to be the raw materials for paper manufacture in the United States until about 1863, when the first wood pulp process was installed. The rapid expansion of wood pulp production, first by the mechanical and soda processes, then by the sulphite process, and finally by the sulphate or kraft process, supplanted the use of straw for practically all types of paper except corrugating paper. This development of new pulping processes and change in raw materials brought about a revolution in the technology and economics of paper and board making.

Low-cost groundwood pulp was found to be especially suited for newsprint and cheap magazine and tablet paper, resulting in greatly expanded publication of newspapers and periodicals. The longer fibers of chemical pulps from coniferous woods produced good writing and book paper as well as lightweight and strong wrapping paper. These coniferous wood pulps supplanted to a very large extent the relatively crude straw pulp and the expensive rags, which were generally in short supply. New paper mills were built on streams which could produce water power and, later, electric power for grinding wood and for operating machinery. Pulpwood logs were floated down the streams from the forest to the paper mills. Wood was plentiful, denser than bulky straw, easier to collect, and less costly to transport. As a result, practically the whole technology of papermaking developed in the past 80 years has been built around the use of wood although straw pulp and, to a smaller extent, rag pulp, are still used to produce specialty papers and paper products.

The main use of straw by the United States paper industry at the present time is for the production of corrugating paper for boxboard and shipping containers. The first corrugated paper was invented in 1871 by Albert L. Jones. In 1874 Oliver Long developed a method of lining corrugated straw paper with a flat sheet of paper on one side. This single-faced corrugated paper found instant popularity for packing glassware such as lamp chimneys, bottled goods, and the like. Double-faced corrugated strawboard was used about 1890 for manufacturing shipping containers and boxes. The approval for use of these containers for express shipment by the Wells Fargo Co. in 1895, and for freight shipment of cereals in 1903 greatly stimulated the production of strawboard for corrugating.

A considerable amount of strawboard is used for egg case fillers, chip board, setup boxes, special cartons, and paper cap stock, but its major use is as a corrugating medium in the manufacture of corrugated boxboard. Stiffness, smooth surfaces, and adaptability for forming corrugated flutes at high speed are the most important properties of the strawboard. The fluted tips or crown are touched with sodium silicate, starch, or other adhesives and a liner is applied to one or both sides. Ordinary strawboard is light yellowish brown, 0.009 in. thick, and weighs 26 to 32 lb. per thousand sq. ft. The strawboard is sold on a weight basis but is resold by the box manufacturer on a square foot basis. Competition within the corrugating board industry has tended to maintain the required physical properties of the sheet and at the same time to reduce its density.

Although the methods and machines for producing board and paper from straw have kept pace, more or less, with the advances in the production of wood pulp papers, the manufacture of straw pulp has not changed much since the beginning of this century. In the earlier production of straw pulp, the straw was boiled with a solution of lye or of milk of lime. For the production of strawboard for corrugating, the manufacturers preferred milk of lime, and this chemical was used almost exclusively in this industry until recent years.

The early commercial production of straw pulp for corrugating took place in open tubs. These units, about 20 ft. in diameter, and about 10 ft. deep were filled with alternate layers of raw straw, from the hay rack or pile, and milk of lime, and the whole was cooked with low-pressure steam for 8 to 10 hr. After sufficient time for cooling, the cooked straw was forked from the tub onto conveyers and then washed, beaten, and made into paper in the paper mill. A gradual change-over from open-tub cooking to the use of globe rotary cooking took place around the turn of the century.

Lime continued to be practically the sole cooking agent for corrugating straw pulp until about 1920 when extracted chestnut chips, from which the tannin had been removed by water extraction, and kraft pulp began to produce, competitively, 9-point corrugating paper which was accepted by shippers. The outstanding advantages of lime as a pulping agent are its low cost and relative insolubility in water. Small amounts of lime produce large quantities of saturated lime water; as the lime is used up or neutralized in the pulping process more of

S. I. Aronovsky, Chemical Engineer, in charge pulp and paper section, Agricultural Residues Div., Northern Regional Research Laboratory, one of the laboratories of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture, Peoria, Ill.

the unused material is dissolved and a saturated solution is thus maintained until all of the lime has been absorbed by the straw or converted to other products. Cooking with lime, therefore, required no particular controls, as long as there was sufficient chemical present to do the required job of pulping. Also, more uniform pulping conditions could be maintained with lime than with similar small amounts of the other conventional cooking chemicals, which would tend to be absorbed by a small portion of the straw, leaving the remainder of the straw partly or completely unattacked by the chemical.

The disadvantages in the use of lime for pulping are that lime and its salts are difficult to remove from the cooked straw in the usual washing cycle, resulting in an alkaline reacting pulp. The lime salts gradually fill up the wires and the felts of the paper machinery resulting in frequent shutdowns and consequently lower production. Also the frequent washing or "souring" of the wires and felts with acid shortens the life of the clothing considerably.

The advent of chestnut and kraft pulp into the corrugating field caused the strawboard industry to look into ways and means of improving the quality of their product. A number of these strawboard mills began investigating the possibilities of using soda salts and sulphur in addition to lime for pulping the straw. Many such chemicals were tried, including caustic soda, soda ash, sodium sulphate, and sodium sulphide, and, in a number of cases, elemental sulphur was added to the rotary charge.

Strawboard made from straw cooked with only lime carries over a peculiar odor. It was found that eggs held in cold storage in cases with a lime-cooked strawboard filler acquired an unpleasant musty taste which could not be attributed to the eggs, and was ascribed to contact of the eggs with the strawboard and absorption of its undesirable odorous constituents. This particular strawboard odor can be reduced or eliminated by pulping the straw with sodium sulphite or with soda ash and sulphur. The use of these added chemicals resulted in improving the quality of the strawboard corrugating paper, but the chestnut and kraft pulps continued to make inroads into this field.

Briefly, the operations for manufacturing strawboard for corrugating are as follows: baled straw from the mill rick or from a truck is conveyed into the digester house. The bale wires are cut and removed and the partially broken bales are loaded into 14-ft. spherical rotary digesters with a capacity of about 6 tons of air-dry straw. The total chemical charge varies from 5 to 9%, basis air-dry straw, and the water charge is 500 to 625 gal. per ton of straw. The straw charge itself varies from 3 to 6 tons depending on the number of fills used, for instance, 1 to 4. The cooking pressure is 5 to 60 p.s.i. and the cooking time at maximum pressure varies from 3 to 13 hr. The cooked straw is dumped onto chain conveyers which carry it to seasoning pits or to washers. The old practice of draining and seasoning the hot, lime-cooked straw for 48 to 60 hr. before sending it to the beaters is still practiced in some mills. The cooked straw is beaten for 2 to 3 hr. at 4 to 7% consistency, with simultaneous washing by means of washing drums to remove the cooking chemical, very fine fiber, and debris from the pulp. Other defibering and refining equipment such as rod and disk mills are used by some plants. The beaten stock is passed through two or more jordans and then generally screened before it is formed into a sheet on the paper machine. The latter is generally a cylinder machine but some mills use fourdriniers. The formed sheet is pressed, dried, lightly calendered, reeled, and slit and rewound to the customer's specifications, as in the manufacture of other papers. In spite of all the variations enumerated above in the different mills, a check test run in 1947 on the strawboard produced by these mills showed that the corrugating paper manufactured by the various procedures was remarkably uniform in quality.

That was the status of the corrugating strawboard industry in the United States in 1940, when the Northern Regional Research Laboratory of the United States Department of Agriculture was organized and started work on the utilization of straw and other agricultural residues for the production of pulp, paper, and board products. This was also about the time when combine threshing of grain had largely supplanted the binder method and difficulties were encountered by the mills in straw procurement. The first efforts of the Northern Laboratory were aimed, therefore, toward helping solve this procurement problem, involving the development of specifications for baled straw and of equipment to gather and bale it. The Laboratory also helped the strawboard industry develop suitable methods of preserving the baled straw in storage in large ricks. A 400-ton rick can be suitably protected from microbial attack by dusting the top layers of straw bales with about 1 ton of crude borax.

CORRUGATING STRAWBOARD

In the meantime experimental work was carried on at the Northern Regional Research Laboratory on methods of improving the pulping of straw for corrugating. Preliminary experiments showed that cooking straw with 6% lime and 1.5% caustic soda, a mathematical average of the amounts of chemical used in the commercial production of strawboard in the corrugating industry, gave a pulp which was essentially similar to that produced by the industry. With these conditions as a base for laboratory pulping, many experiments were tried with varying proportions of the different chemicals commonly used for pulping, and an empirical method of evaluating the straw pulp was developed, using a 5-lb. beater with a washer attachment for defibering and washing the pulped straw. These preliminary laboratory experiments showed that caustic soda, sodium sulphite, or a combination of the latter with caustic soda or with soda ash, with elimination of all or most of the lime, gave pulps with considerably higher Riehle crush resistance than could be obtained by

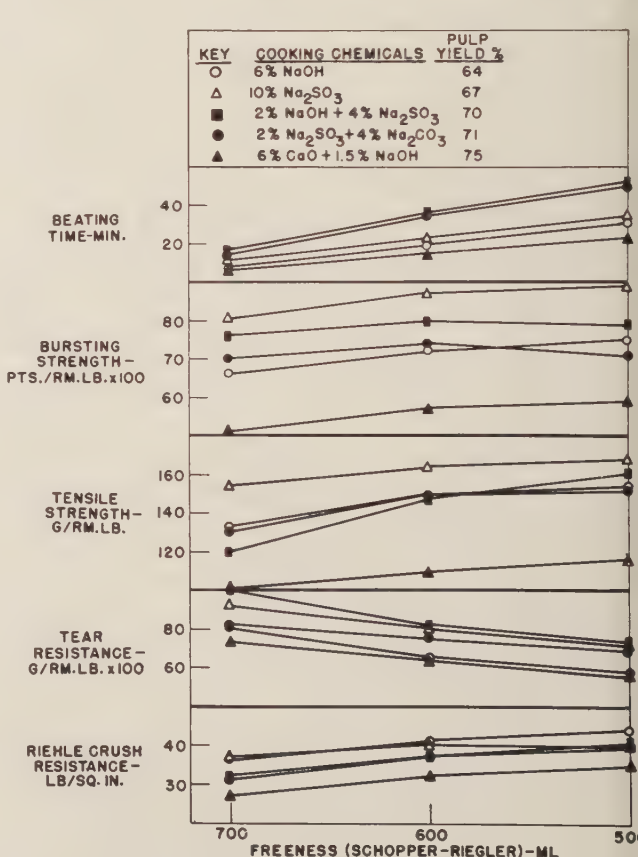


Fig. 1. Yields and properties of corrugating straw pulp produced with sodium compounds as compared with regular lime-cooked pulp

cooking with lime alone or with large proportions of lime in the formula.

With the greatly increased production and improved quality of corrugating wood pulps, particularly the semichemical hardwood pulps, the Northern Laboratory concentrated more directly, with active cooperation of the strawboard industry, on developing improved pulping methods for straw. Four men from three strawboard mills participated actively in this work. Four new pulping formulas were developed, each capable of producing a superior corrugating straw pulp. It was considered desirable to develop more than one type of formula so that each of the strawboard mills, with its different equipment and methods of operation, could use the formula which came closest to its own conditions. These chemical formulas were 6% caustic soda, 10% sodium sulphite, 2% caustic soda plus 4% sodium sulphite, and 2% sodium sulphite plus 4% soda ash, all based on the oven-dry weight of straw (Fig. 1). The pulps obtained by cooking with these chemicals were vastly superior in strength properties, particularly crush resistance, to lime-cooked straw pulp. Most of the mills in this country producing strawboard for corrugating have adapted these cooking formulas to their commercial operations, and some have produced corrugating strawboard with crush resistance superior to that of the semichemical hardwood corrugating paper. These results corroborate the often-repeated claim of the Northern Laboratory that straw pulp and pulp from similar high-hemicellulose agricultural residues would make corrugating paper with crush resistance superior to that of wood and other plant materials which have lower amounts of hemicellulose.

MECHANO-CHEMICAL PROCESS

It was during this period that the new revolutionary mechano-chemical process for pulping agricultural residues was developed at the Northern Laboratory. This process involves cooking the raw material in an open vessel at atmospheric pressure and at temperatures up to 100°C. The vessel used in this development was a Hydrapulper. The rapid pulping rate was attributed to the impact action of the impeller of the Hydrapulper in forcing or "pumping" the chemical liquor into and out of the straw or other agricultural residue material. This process is not limited to the use of the Hydrapulper since other equipment which produces similar impact action has given equally good results. The main requirement of the equipment is that it circulate straw and chemical at a sufficiently high rate so that a good vortex is developed and maintained in the unit, resulting in rapidly repeated impacts of the straw particles by the impeller vanes. This result was obtained in a commercial Hydrapulper by using a larger rotor or impeller than is required for defibering dried pulp or wastepaper.

Straw cooked in a 3-ft. Hydrapulper for 1 hr. at 98°C., with 6% lime and 1.5% caustic soda, gave a pulp which was fully equal in yield and strength characteristics to that produced by cooking with the same amount of chemical for 5 hr. at 140°C. (40 p.s.i.). The ratio of total liquid to straw at the beginning of the cook was 9:1 and the final consistency at the time of discharge was about 6.5% due to solution of some of the straw constituents and dilution with the cooking steam. With caustic soda the mechano-chemical process produced a corrugating pulp in high yield, and with properties similar to those of pulp produced by cooking straw with the same amount of caustic under the usual pressure cooking conditions.

Commercial-trial pulping of straw in an 11-ft. Hydrapulper corroborated the results obtained with the smaller laboratory unit. As a matter of fact, the larger equipment seemed to do a better and faster job of pulping. Straw was cooked with lime and soda ash, lime and caustic soda, and with caustic soda alone, using the same total amount of chemical as required for pressure cooking in the standard 14-ft. rotaries. The wire was removed from the bales at the Hydrapulper and these bales were then dumped whole into the hot liquor in the unit. The starting straw consistency was 10%. After cooking for 1 hr. the pulped straw was discharged by gravity flow through a 16-in. line in a matter of 2 or 3 min. The complete time cycle for filling, cooking, and discharging was not more than 90 min. The pulp so produced was fully equal in strength characteristics to that made by cooking with the same amount of chemical for 5 to 6 hr. at 50 lb. pressure in the globe rotary. No particular difficulties were encountered in producing corrugating paper from this pulp on a commercial cylinder paper machine. The corrugating paper was similar in all respects to that produced by the regular production methods at this particular mill.

In another mill trial wheat straw and sugarcane bagasse were pulped in a 3-ft. Hydrapulper with caustic soda. The cooked materials were defibered in a Bauer refiner and run over a small experimental fourdrinier paper machine to produce 9-point corrugating paper. This paper was then corrugated on a large commercial machine and attached to a single liner. The resulting single-faced corrugated board had considerably higher flat crush strength than boards made from bogus corrugating or from cold caustic semichemical mixed hardwood pulps produced on the same paper machine.

The main advantages of mechano-chemical processing lie in lower labor and steam requirements, a saving in space, and simplicity of operation and control. This process is capable of push-button, streamline operation. Mill insurance rates in operation of this process can be lower because no pressure equipment is involved.

FINE PAPER PULP

As indicated previously, there is at present no commercial production of fine or bleached pulp from cereal grain straw, bagasse, or similar agricultural residues in this country. Bleached fine pulp from straw was used in blends with wood and rag pulps for various grades of paper, including newsprint, up to the first decade of this century. Since that time straw has been used for the production of only the coarser grades of paper and for paperboard, leaving the field of fine paper almost entirely to wood and rag pulps. A fair tonnage of tow from seed flax straw is used in the production of cigarette, condenser, and similar high-grade papers. A small amount of cotton linters is being processed for use in paper manufacture. A small mill was reported producing bleached pulp from rice straw in California about 30 years ago but that mill is no longer in operation. Before World War II several hundred tons of bleached straw pulp were imported annually from Europe for use in Bristol, drawing and art papers, and for similar specialty products.

Interest in straw pulp for paper manufacture was renewed during World War II and has increased since that time due to greater demand for paper and board, lessening supplies of pulpwood and wood pulp, and greater costs of these materials. Research work on the production of fine pulp from straw was begun at the Northern Laboratory in 1940 when the program on pulp and paper was set up. It was decided early in this program that the best way to make straw pulp attractive to the paper industry was to put the manufacture and use of this material on a sound economic and practical basis. The conception of producing straw pulp merely as a substitute for other types of fibers during periods of shortage was discarded as unsound. For continued use by the paper industry, straw pulp or pulp from similar agricultural residues has to provide a property or effect which cannot be produced so easily or so well by other types of pulps. These agricultural residue pulps must be considered as supplementary rather than substitute raw materials for the industry.

A considerable amount of work has been reported in the literature on the pulping of straw and other agricultural residues, but most of this work refers to scattered or isolated

experiments from institutional or pulp and paper mill laboratories. The Northern Laboratory established for the first time a broad pulp, paper, and board research program devoted entirely to the use of such agricultural residues. The pulping and pulp and paper characteristics of these residues could thus be evaluated in one place, under a unified set of conditions, and the results would therefore be fully comparative and easily understandable.

It is known that while the alpha-cellulose contents of straw, bagasse, and similar agricultural residues are lower than those of wood, the holocellulose contents of these materials are practically all alike, with the agricultural residue materials containing more hemicelluloses or pentosans than woody plant material. The first work in the Northern Laboratory program for fine pulp involved, therefore, a search for a pulping method which would give a pulp with a yield as close to the holocellulose value as possible. After experimenting with a large number of pulping agents, organic as well as inorganic, it was found that the most practical method of producing a high yield of suitable pulp from straw was to cook the material by the neutral sulphite method. Comparable pulping studies on wheat straw were also made with the soda, kraft, acid sulphite, and ammonia processes. The acid sulphite and ammonia pulps were quite weak. Good quality pulps were obtained by the soda and kraft processes but the pulp yields were considerably lower than those produced with the neutral sulphite method.

Neutral Sulphite Process

The optimum condition for pulping soft winter wheat straw, for example, was 8% sodium sulphite and 3% sodium carbonate, based on oven-dry straw, 2 hr. cooking at a maximum temperature of 170°C. (100 p.s.i.), and a liquor to straw ratio of 7:1. At the start of cooking, the temperature was brought up to maximum as rapidly as possible, usually 15 to 20 mins., and at the end the pressure was lowered as rapidly as possible, without excessive loss of liquor, to about 40 p.s.i. The charge was then blown into a blowpit. Afterwards it was washed, screened on an 8-cut flat plate, and bleached. The average yields, based on oven-dry straw, obtained in this operation were: crude pulp, 62%; screened pulp, 54%; screenings, 2%; and fines, 6%. Discharging the digester contents under pressure almost completely eliminated, more or less, the difficulties with slow stock encountered in European and South American practices of producing straw pulp. Upon blowing, the nodes and rachises, or heads, exploded into their constituent tiny fibers, platelets, and cells which could be screened out by deckering, or by an additional screening step. The screened neutral sulphite pulps have unbeaten freeness values of 800 to 820 ml. Schopper-Riegler which is a fairly high freeness for short-fibered pulp. This pulp requires about 5% total chlorine to bleach to a brightness of 70 in a three-stage operation; about 7 to 8% chlorine produces a brightness of about 80. The yield of bleached pulp, based on original dry straw, varies from 47 to 50%, depending on the brightness of the pulp attained.

A commercial trial of this process was made in a large Canadian newsprint mill under conditions which were very difficult because of the need to avoid interference with regular newsprint production. About 7 tons of screened pulp were produced, and the calculated yield was about 52%, based on original straw. This pulp was bleached and incorporated into the regular commercial newsprint paper, forming 17 to 20% of the total furnish. This furnish was run on a 183-in. paper machine at 1120 f.p.m., and no breaks were encountered during the entire run of about 6 hr., with a production of approximately 35 tons of paper. This paper, printed on the presses of a large American daily, produced 163,000 copies of a 28-page newspaper, again without a break which could be attributed to the paper. The straw-containing commercial newsprint paper had somewhat smoother surfaces, and the formation was somewhat better than that obtained in the regular all-wood sheet. This process is now being used, with more or less modification, for the commercial production of straw pulp in a number of European countries.

Fine Mechano-Chemical Straw Pulp

The mechano-chemical process for producing fine pulp from straw and similar raw materials at atmospheric pressure was announced by the Northern Laboratory in February, 1949. An excellent pulp can be produced from straw by cooking the latter in a Hydrapulper for 1/2 hr. at 98°C. with 10 to 12% caustic soda or kraft chemicals, based on dry straw. This process is not efficient for use with sodium sulphite which requires higher temperatures for practical pulping.

The screened (8-cut) mechano-chemical pulp is fully equal in strength properties to that obtained by cooking with the same amount of chemical for 2 hr. at 170°C. (100 p.s.i.), but the yield of mechano-chemical screened pulp is 53 to 55%, as compared with 45 to 47%, obtained by the pressure cooking method (Table I). This mechano-chemical process also produces relatively free pulp, with an unbeaten Schopper-Riegler freeness of 750 to 800 ml.

The nodes and rachises are eliminated in this process also, but in a different manner from that obtained in the neutral sulphite method. In mechano-chemical pulping the nodes, rachises, and seed kernels are swollen but not pulped. After cooking in the Hydrapulper, the material is washed and then sent to a riffler at a consistency of about 0.5%. The swollen nodes, rachises, and seeds settle out quite readily in the riffler, and only a small portion of these materials is carried over to be caught on the 8-cut flat screen. The lower fines content of the mechano-chemical straw pulp also is laid to the fact that the nodes and rachises are not broken up in the Hydrapulper. Mechano-chemical soda pulp from straw has been bleached to a brightness of 82.4 in pilot-plant operation, with a total chlorine consumption of 8.7%, based on original dry straw, in a three-stage operation involving chlorine, alkaline extraction, and hypochlorite. The yield of bleached pulp was found to be 47% of the original weight of dry straw.

Straw Pulp—Wood Pulp Blends

This bleached straw pulp was blended with wood pulp in the production of various grades of paper on an experimental fourdrinier paper machine. Control runs of all-wood pulp furnishes were made on the same machine. The straw pulp was beaten to a Schopper-Riegler freeness of 500 ml. (Canadian Standard 190 ml.) in all cases, and the wood pulps used

Table I. Comparison of Wheat Straw Pulps Produced by Various Processes

Item	Process				
		Kraft		Soda	
	Neutral sulphite	Mechano-chemical	Pressure	Mechano-chemical	Pressure
Per Cent Yields[a]					
Crude pulp	62	63	53	62	52
Screened pulp	54	55	47	53	42
Screenings	2	4[b]	1	5[b]	3
Fines	6	4	5	4	7
Constituents in Screened Pulp, %					
Ash	7.9	1.9	4.9	1.3	4.7
Lignin	5.4	6.1	4.0	6.6	5.3
Pentosans	29.1	32.5	30.0	34.5	23.2
Strength at 500 Ml. S.-R.					
Bursting[c]	96	105	99	109	104
Tensile[d]	174	194	175	184	188
Tearing[d]	53	55	46	49	55
Folding[e]	350	450	470	660	810

[a] Basis oven-dry straw.
[b] Rifflings plus screenings.
[c] Points per ream-pound.
[d] Grams per ream-pound.
[e] Double fold (Schopper).

the blends were beaten in the same manner as for the control runs. The following papers were made using bleached sulphite or unbleached kraft wood pulps in the controls: magazine-book for coating, including groundwood in the furnish; newsprint from a furnish of blank news and sulphite in one case and blank news and straw pulp in the other; soda book, including soda wood pulp; bond; waxing; and kraft for wrapping and bag. A greaseproof or glassine sheet was also made from a furnish of 75% of the mechano-chemical straw pulp and 25% sulphite pulp which were beaten together to a freeness of 200 ml. Schopper-Riegler. The proportions of the bleached straw pulp in the furnishes of the other papers varied from 25 to 60% of the furnish.

In all cases better formation and smoother surfaces were obtained when straw pulp was used as part of the furnish. The paper containing straw pulp also invariably had higher burst and tensile strength, as well as higher folding strength than the all-wood pulp paper. The tearing resistance was lower, of course, for the straw-containing paper because of the shorter fiber length of the straw pulp.

The improved formation of the paper containing straw pulp is due mainly to the very narrow diameter of the straw fiber, and consequently, to its high length-to-diameter ratio. This improved formation is confirmed by the fact that where straw pulp was added to the furnish the difference in the strength properties of the paper in its two directions was decreased, i.e., the strength in the cross direction increased to a greater extent than that in the machine direction. The smoother surfaces of the straw-containing paper are due primarily to the fact that the straw fibers in the paper surfaces were relatively unfibrillated and smooth. Straw pulp with its relatively high hemicellulose content hydrates so rapidly that the maximum strength values of the pulp are obtained before the fibers are bruised to any large extent. From a practical standpoint, this property of the straw pulp means a saving in power for beating or refining.

RECAPITULATION

With the cooperation and encouragement of the American paper and board industries, considerable advance in the utilization of straw pulp can be reported. The new pressure pulping formulas and the mechano-chemical process for strawboard pulp give promise of returning straw to its former preeminent position in the corrugating board industry. Similarly, the high-yield neutral sulphite process and the equally high-yield mechano-chemical process bring the production of fine paper pulp from straw into the economic range of present-day competitive pulps from other raw materials. These new developments and the constantly and greatly increasing interest of the pulp and paper industry emphasize the possibilities of straw for fine pulp and paper manufacture in the United States. It appears probable that these fibrous agricultural residue pulps will attain a permanent place as raw materials in the American pulp and paper industry in the very near future.

CONCLUSION

Agricultural fibers of diverse nature are readily available in most parts of the world. Research into their physical, chemical, and papermaking properties backed up with a considerable industrial experience in their use shows that they can greatly benefit the expanding paper industry not only by increasing pulp supplies but even more important, when properly used, to produce new and improved paper and board products. Now, industry is somewhat reluctantly extending the present limited use of these fibers. The greatest challenge to industry in this period of expansion lies in a reorientation in viewpoint so that raw materials are not confined to any particular type but are sought and used on the basis of producing better, newer, and more useful paper and board products. With such a reoriented viewpoint, the very great possibilities in the use of agricultural fibers become apparent. With such a viewpoint, research and industry can proceed to solve the problems facing them with confidence.

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The mention in this publication of commercial products under proprietary names does not constitute an endorsement by the U. S. Department of Agriculture.

Organization of a Small Engineering Laboratory

A. W. POMPER

MUCH has been written about industrial laboratories and many of the books, technical papers, and articles are concerned with engineering management and control of engineering research and development. Most of the attention has naturally been given to the large laboratories where the problems of organization and management are recognized as real and important. When we consider the number of smaller manufacturing firms of insufficient size to support a large laboratory, however, the need for consideration of the problems of the small laboratories becomes evident. According to a U. S. Department of Commerce survey (*1*), firms of 500 employees or less comprise almost 99% of all manufacturing enterprises and include over 41% of all manufacturing employees. An earlier survey (*2*) shows that over 97% of the machinery manufacturers employ less than 500 persons and a similar distribution exists in the manufacture of paper and paper products. Surely the laboratories of these companies, while individually small, are important because of their number.

Organization and management control may not at first appear to be necessary in the small laboratory with fewer than a dozen persons, less than half of whom are professional, technical personnel. The activities could be conducted by the technical personnel with negligible supervision and control, but with slight guarantee that the technical talents will be used to the best interests of the company, that the operations will not consist almost exclusively of urgent short-range projects with neglect of more important but less pressing long-term work, that the money spent will be used most effectively, or that the results of today's activities will be useful not only for the immediate problem but also for all similar problems in future years. Objectives must be decided upon, budgets must be planned, priorities determined, work assigned, and results evaluated. These are the duties of laboratory management whether we consider control of hundreds of technical personnel in a company employing thousands or supervision of a few engineers in a firm of less than a hundred employees.

The John Waldron Corp., with several hundred employees engaged in the design and manufacture of paper, plastic, and textile converting machinery, is one of the large number of smaller manufacturing firms mentioned above. Examples from the practice of the engineering laboratory maintained by this company will be used to illustrate the points brought forward in this paper.

ESTABLISHING A LABORATORY

An engineering laboratory may spring into existence suddenly or it may be born and grow slowly, expanding as its accomplishments justify further expansion. In either case, it has been created and has grown because there is a need for its services. If sales are falling off, if competition is regularly producing better products or is marketing products of comparable or superior quality at lower prices, the need for an

A. W. POMPER, Engineering Laboratory Director, John Waldron Corp., New Brunswick, N. J.

engineering laboratory is indicated. If one or all of these problems are recognized by manangement as being sufficiently serious to justify immediate action, steps may be taken to establish a laboratory where there was formerly no research or development in any form. Often the problem is not so clearly defined, however. The full realization of the need for some separate unit within the organization of the company which can be responsible for originating and developing new products may not come until work of this nature has already been carried on for some time by a limited number of personnel. For example, management may foresee the need for a new type of machine and assign one of its engineers to the task of designing this machine. Perhaps the design problem requires simple tests of various sorts in order to provide sufficient information to proceed intelligently with the design. The engineer in charge, if he is of a practical nature, may find some place within the building to set up limited equipment for these tests. When the design has been completed and the machine built he may arrange to operate it before it is sent out or sold. The knowledge gained from this operation may result in further changes of the machine. After several projects of this nature have been completed over a period of perhaps several years it should become evident that if there were a definite group responsible for such work with the equipment, facilities, and personnel required to carry out the work properly, the results would be most beneficial to the company. In any case, the laboratory evolved or was set up because a need for its services existed.

The Waldron Laboratory has been in existence for many years, operating with a limited number of personnel. With increasing competition in recent years a need for expansion became evident. As the existing laboratory had proved that valuable results could be obtained, it logically followed that expansion of activities with requisite increase of personnel and facilities would be of even greater benefit. Plans were therefore made for the addition of personnel as required for the functions assigned to the laboratory, purchase and construction of additional instruments and equipment, and construction of a new laboratory. (*See* Fig. 1.)

Once the need for a laboratory has been established, the functions it should perform must be determined. These functions can be and usually are quite varied in a small company. Research, development, design, technical service, testing, quality control, and even some aspects of advertising and sales may rightly be considered with the scope of the small engineering laboratory. Naturally many laboratories will perform only one or two of these functions. One laboratory may conduct only routine tests on machines which have been designed without the benefit of experimental work, while another may be responsible for quality control of standard production items. Applied research and development are the fields of many. The functions are generally determined by the size of the company, the product which it manufactures, and the other departments which are capable of performing some of the required operations. Often design can be handled very well by the engineering department with the assistance of the laboratory in securing pertinent data. If this design is a direct outgrowth of research and development work, however, it may be preferable to have the design continued by the same group or by the same person who conducted the development work rather than to familiarize another department with the requirements and coordinate the transfer of information between the departments. A company which manufactures repetitive items will require research and development to produce new products and quality control to maintain the standards of production. It will have little need for technical service other than as a part of development at the beginning of production of a new item. The requirements of a manufacturer of special machinery are primarily development and design with greater emphasis on technical service due to the fact that equipment which is sold in limited quantities and involves several thousand dollars per unit cannot be as exhaustively tested as relatively inexpensive products which are mass produced.

The four major functions of our laboratory are research and development, sales development, design and technical service. Research and development include both short-term and long-term projects aimed at investigating the fundamental principles of converting operations, application of these principles to the construction of improved machinery, and thorough testing and evaluation of this machinery. Sales development involves converting operations on a pilot-plant scale, generally using a customer's raw materials to produce the product he requires, in order to determine the type of equipment best suited to the operation, and demonstration of the equipment and operations to the customer. Design is the link between development, sales, and production of machinery, and involves understanding and consideration of the results of the development projects, manufacturing methods, and the sales requirements. Technical service requires the experience of engineers who know both the fundamental theories behind the proper functioning of a machine and the operation of the machine in order to effectively assist a customer in starting up a new line of equipment, to correct improper operation of a machine, and to evaluate the problems encountered in the light of possibly suggesting research and development projects to produce new or improved apparatus.

These four major functions are all closely related. Observations made during technical service calls lead to engineering research and development work. The results of development can be directly translated to an immediately practical form through engineering design. Sales development often suggests research and development projects, and serves to demonstrate the equipment produced by the combination of development and design.

When the functions of the proposed laboratory have been determined decisions must be made as to how well and how quickly the objectives are to be realized. This can be done by specifying the number of employees, both technical and nontechnical, who are to be made available, and by approval of major expenditures as they are required, or preferably an annual budget may be proposed by the director and approved by management leaving the director free to make the best possible use of the money available. A survey by the National Association of Manufacturers serves as a valuable guide in deciding on the annual budget (*3*). Of the 400 companies reporting sales volume of $5,000,000 or less per year, a weighted average of slightly over 2% of the sales volume was spent on research with the smaller companies allocating the higher percentages of their sales for research purposes. These figures represent the expenditures of established laboratories, of course. If it often wiser to start somewhat more conservatively, increasing the budget after successful operation of the laboratory has proved its value.

Personnel problems are usually the responsibility of the laboratory director in a small company, and any time spent on this phase of organization will be amply repaid by the efforts of personnel doing the work for which they are best qualified and in which they are most interested. The qualifications, aptitudes, and emotional characteristics should be carefully considered when attempting to fit men into the right jobs. Dependability is generally more important than interest in the performance of routine testing and quality control, while the value of enthusiasm cannot be stressed too highly for the performance of applied research and development. Technical service requires, in addition to technical ability, a high degree of tact and diplomacy.

The number of personnel depends largely on the annual budget although the director must decide on the distribution of the budget or allocation for salaries, equipment, etc. Not all the employees need be professional or college graduates, especially in engineering laboratories, where the ratio of nonprofessional technical personnel to professional, technical personnel is higher than in many other types of laboratories

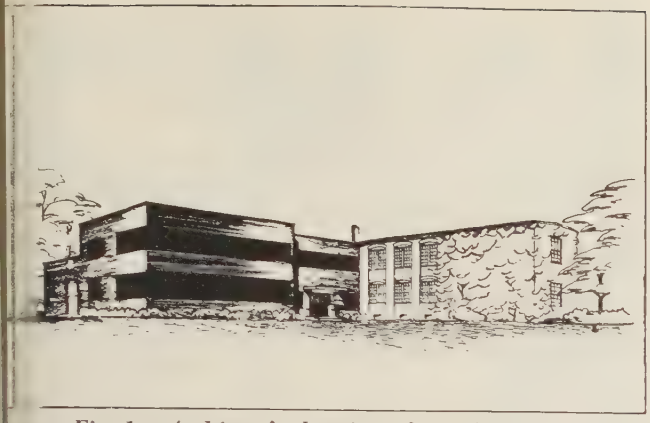

Fig. 1. Architect's drawing of new laboratory

ecially chemical and biological. "Management Controls n Industrial Research Organization" (*5*) gives the following ig ures for 26 mechanical engineering laboratories with fewer h n 50 professional-technical personnel: for an average al personnel of 33, 13 are professional-technical personnel, 3 are nonprofessional-technical, 3 are clerical, and 4 are t er personnel. This is contrasted with the following figres for 94 small chemical laboratories. For an average of 4 total personnel, 12 were professional-technical personnel, were nonprofessional-technical, 3 were clerical, and 3 were t er personnel. The non-professional technical personnel in engineering laboratory include mechanics who can assist n setting up apparatus for tests and constructing prototype quipment for development work, and technicians who can btain and record data leaving the engineering personnel free o devote their time to planning and evaluation of the test esults.

Of the 9 personnel of the Waldron engineering laboratory, 1 are professional-technical, or graduate engineers, and 4 are nonprofessional-technical, including a designer and two engineering assistants with considerable engineering education, and an experienced machinist. This distribution will be maintained with the addition of several more employees upon completion of the new laboratory building.

The initial equipment purchased is influenced by the functions which the laboratory is to perform and by the annual budget. While the instruments and apparatus supplied

ENGINEERING LABORATORY
PROJECT ASSIGNMENT

Project No.:_____ Job. Order No.: _____

Title :_____

Origin :_____

Objective :_____

_____

_____

Classification: Type _____

Duration _____

Equipment Required: _____

Submitted By:_____ Date:_____

Assigned to:_____ Date:_____

Approved:_____

Date Completed:_____ Date Detail Report Submitted:_____

Summary of Results:_____

_____

Signed:_____

Fig. 2 Project assignment sheet

Report Date:

ENGINEERING LABORATORY
RESEARCH AND DEVELOPMENT REPORT

Project No.:
Order No.: (if any)
Objective:
Personnel Engaged on Project:
Duration: (beginning and completion dates, total man-hours)
Procedure:
Results:
Summary:

Signed: (Engineer in Charge)

Attach photographs, calculations, graphs, sketches, etc. to all copies.

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Fig. 3 Research and development report form

when setting up the new laboratory are generally charged to capital accounts, the selection is influenced by the annual budget in that there is no point in purchasing equipment that will not be used for at least several years due to budget limitations on personnel.

The equipment and instruments required vary greatly from one laboratory to another. In all cases, however, it is important that enough instruments be provided to accurately measure the various phenomena with which the work is concerned. Without enough instruments the purpose of the laboratory is partly defeated since one of the reasons for its existence is that it represents a source of information which is impossible to obtain by thought alone and is often difficult to obtain by visual observations of an operation or a process. In a small company with a limited budget, the director must consider the purchase of instruments in the light of proposed future work in addition to present requirements since the purchase of expensive equipment for any one project may not be justified while the use of this equipment for various present and proposed projects may easily warrant its purchase.

Provisions for laboratory space range from a few hundred square feet in a fenced-off corner of the shop to a separate building of several thousand square feet or more. While good results can be obtained with crowded unpleasant working conditions, generally ample, uncluttered operating space with adequate lighting and ventilation will produce more copious results with the additional benefits of more accurate records and reduced equipment and instrument loss and breakage.

A reference library must be maintained for a laboratory to

Report Date:

ENGINEERING LABORATORY
DESIGN REPORT

Project No.:
Order No.:
Objective:
Personnel Engaged on Project:
Duration: (beginning and completion dates, total man-hours)
Description of Design:
Application Information: (all pertinent information for future application such as drive ratings, consideration for web width, etc.)

Signed: (Engineer in Charge)

Calculations must be attached to all copies.

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Fig. 4 Design report form

Report Date:

ENGINEERING LABORATORY
TECHNICAL SERVICE REPORT

Project No.:
Order No.: (if any)
Description of Installation:
Objective:
Duration:
Problems and Corrections: (itemize)
Recommendations to Customer:
Recommendations for Future Design:
Summary:

Signed: (Engineer in Charge)

Attach samples and data sheets (if any) to all copies.
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Salesman Concerned
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J. J: Case
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Fig. 5 Technical service form

function efficiently. This may consist of a few shelves of technical books and journals, or a separate room with hundreds of volumes, depending on the size of the laboratory and the diversification of its interests.

Our new laboratory building (Fig. 1) which is now nearing completion, will include a library, with an up-to-date file of periodicals in addition to reference books. The 6000-sq. ft. building is of modern functional design and fireproof construction, and will include engineering office space, a machine shop, and a large area for development, testing, and converting operations. To replace the present coating and drying line, a complete new line of commercial equipment is being designed and constructed, so that tests will be conducted on equipment identical to that being used in the field. Some of this machinery has already been built and is now in use.

The present laboratory equipment includes a wide variety of instruments, in addition to the pilot-plant scale converting line and weighing and mixing apparatus for coatings used with this line. A Beta Gauge is regularly used to weigh the processed web continuously and without contact by means of radioactive isotopes. A torsiograph and an oscilloscope are being used to study the variations in angular velocity inherent in different types of drive equipment, and the effect of these variations on coating results. Other instruments include a pyrometer, tachometers, thickness gages, a viscometer, balances and spring scales, velometers, pressure gages, and a stroboscope. A press-type camera is used to record the more unusual tests.

Fig. 6. Test run

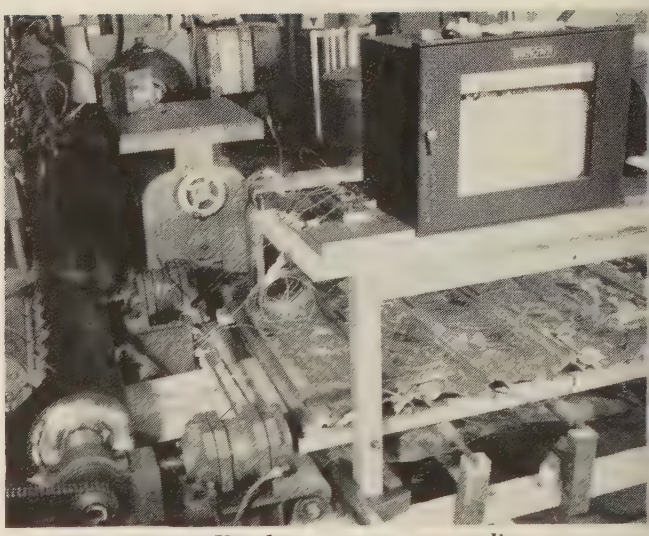

Fig. 7. Vinyl temperature recording

Naturally, since requirements vary so widely, these examples are offered merely as illustrations and not as guides to the selection of equipment.

ORGANIZATIONAL PROCEDURE

The control of a small laboratory is generally quite simple, once certain procedures have been set up. There is no need for fixed operating spheres and formal chains of command—an organization chart would be superfluous. The director can maintain close personal contact with the engineers and assistants, and can keep informed of all activities without periodic written progress reports. Nevertheless, responsibility and authority must be delegated if the director is to have time for more than routine administration—for travel, planning the technical program, careful and objective evaluation of results, and keeping informed on current developments in related fields. If the functions of the laboratory are varied, one or several functions should be assigned to each responsible engineer who acts as assistant to the director, or section head. These assignments are subject to change with temporary rotation of responsibilities when necessary to prevent any person from becoming too specialized, a condition that is undesirable in a small company. Each section head should be well informed of the work progress of other sections so he may take charge when the director and the other section heads are away.

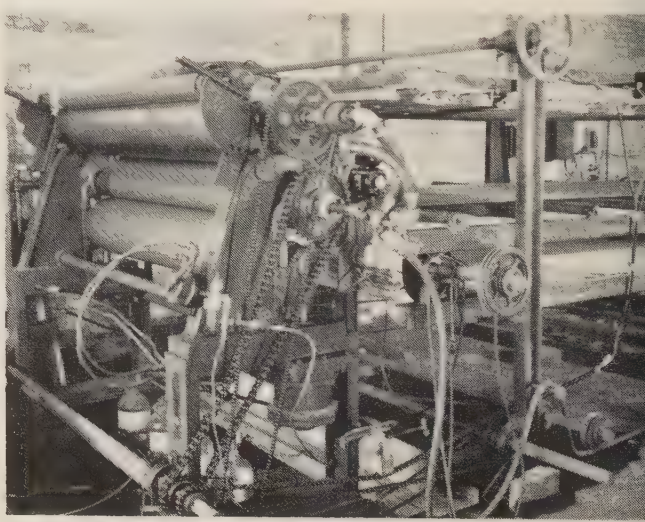

Fig. 8. Developmental vinyl embosser

In our company, the engineering laboratory director plans the technical program, assigns all projects, and handles personnel, purchases, and coordination of activities with other departments. Two project engineers act as his assistants, one being responsible for research and development and the other in charge of routine activities and sales development. Depending upon their nature, design projects may be supervised by the director or either project engineer, technical service projects being handled in the same way. When the director and one of the project engineers are away on technical service calls of for other reasons, the remaining engineer is in charge of the laboratory. In the absence of the director each engineer continues to be responsible for his assigned duties.

A certain amount of caution must be exercised in approving proposed projects for a small laboratory. The projects must not be too abstract, costly, or of too long duration. Yet they should not be too superficial. Perhaps a more common failing in small laboratories is a tendency toward predominately short-term projects due to the exigencies of the moment.

Written project proposals are used in many laboratories, but their use is not universal. The following figures from "Management Controls in Industrial Research Organizations" (*5*) are for laboratories with less than 20 professional technical personnel. Forty-one and six tenths per cent of the laboratories required written proposals for practically all projects, with approval by the laboratory director required in 40.3% of the companies. Fifty and six tenths per cent of the companies reported that approval was necessary from outside the laboratory, primarily by the president or the top technical executive. Eighty-eight and seven tenths per cent reported that at least three quarters of the requests were approved.

All our projects originate as written requests with approval required by the laboratory director. If the project cost is estimated to be more than a few hundred dollars, the president is consulted for verbal approval. The project assignment form shown in Fig. 2 combines the functions of a request, assignment sheet, and brief report, materially reducing the paper work and preventing the policy of requiring requests and reports on all projects from becoming unwieldy.

While written progress reports are generally considered unnecessary in small laboratories, reports should always be submitted upon completion of a project. Even if the human mind were capable of retaining all details of all work for many years, the laboratory could find itself in a position of having to duplicate former experiments if the man with the memory should leave the company. Written reports fulfill the additional function of requiring organization of the project results with consequent clearer understanding of the possible benefits of the work. Prescribed procedures for report writing guarantee that all pertinent information will be included. Figures 3, 4, and 5 show prescribed forms for research and development reports, design reports, and technical service reports. These reports are distributed to all departments which may benefit by the information or which will be responsible for making recommended corrections.

The laboratory director should write monthly and annual reports to his superior, summarizing activities, expenses, and results.

Records of man-hours spent on the various projects and expense records aid the director in analyzing the effectiveness of the technical program, help to decide changes in distribution of personnel and funds, and assist in decisions on expenditures for instruments and equipment. A bound notebook with consecutively numbered pages should be used to record daily activities for future references.

Many companies require each research worker to maintain an individual bound record book, with the results of each day's work entered, dated, signed, and witnessed. This policy is valuable for patent protection. The laboratory record book, mentioned above, can be used to reduce the complexity of record keeping, with one man in charge of entering routine activities and each engineer responsible for entering his own work at the end of each day. Assembling information for patent application is often handled by the director, but even small companies may have one man outside the laboratory organization responsible for securing patent protection on all novel ideas from the various company departments.

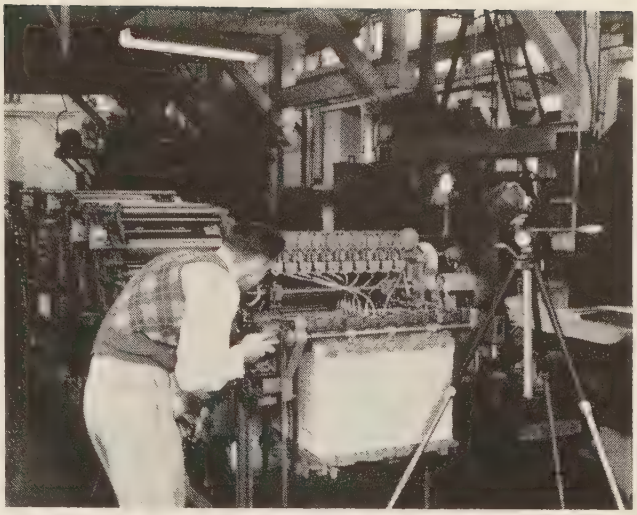

Fig. 9. Test on high-speed offset press

DESCRIPTION OF ILLUSTRATIVE PROJECTS

The type of work done in the engineering laboratory used to illustrate this paper can be understood more clearly by means of brief descriptions of several projects. Figure 6 shows a simple test—the experimental application of a special compound to paper by means of a steam-heated engraved roll, with the customers' representatives observing the test. Coating weight is observed on the instrument in the background, and samples are removed for inspection and records after the web has passed through the tunnel drier not shown in the photograph.

Figures 7 and 8 show two phases of a research and development project which led to the construction of a new plastic embossing line. The temperature of the vinyl web shown emerging from a radiant heating zone in Fig. 7 is being measured at various points by means of thermocouples connected to a Brown six-channel recorder. The apparatus in Fig. 8 is a full-size embosser being tested in order to obtain additional information on embossing requirements.

Another research and development project is illustrated in Fig. 9. A stroboscope with a high intensity 10-microsecond flash is being used to observe the action of the delivery mechanism of a high-speed web-fed sheet delivery offset press. The operating speed of the press was more than doubled as a result of the project.

LITERATURE CITED

1. U. S. Department of Commerce, Business Structures Division, Office of Business Economics, "Survey of Current Business," May, 1951, pages 13, 19, 20.
2. U. S. Department of Commerce, Business Structures Division, Office of Business Economics, "Survey of Current Business," May, 1944, pages 12 and 13.
3. National Association of Manufacturers, "Trends in Industrial Research and Patent Practice," Jan., 1948.
4. Anthony, R. N., "Management Controls in Industrial Research Organizations," pages 458, 459, 460, 461, Cambridge, Mass., Harvard University Printing Office, 1952.
5. Anthony, R. N., "Management Controls in Industrial Research Organizations," pages 113, 121, 123, Cambridge, Mass., Harvard University Printing Office, 1952.

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Decortication and Pulping of Seed Flax Straw

SIDNEY D. WELLS

THE unique physical properties of paper made from linen rags has been recognized for many centuries. It is outstandingly superior for banknote paper and, particularly, currency paper where ability to withstand folding and wear is especially important. The domestic sources of linen waste for paper are far inadequate for the requirements of the fine paper manufacturers engaged in this field and foreign sources are depended upon. During times of war, particularly during the First and Second World Wars, the supply was cut off and cotton was substituted. Currency paper made without linen rags to the extent of at least 50% of the furnish was reported to have an average life of only 4 months whereas, with 50% or more in a mixture with cotton, the average time elapsed before replacement with new currency was necessary was 1 year.

On account of the extensive treatment given the fiber in preparation for textile purposes, the textile waste and especially cuttings from factories converting the woven fabric to garments or other products, are substantially free from shive or other nonbast constituents of the straw, and treatment of such waste by milk of lime in rotary boilers is sufficient preparation for the subsequent steps used in papermaking. Degradation of the cellulose is negligible with the lime cook, and paper of adequate wearing properties results, provided proper care has been exercised in the subsequent washing, bleaching, and stock preparation.

When the importation of linen rags is interrupted on account of a blockade, as was the situation during World Wars I and II, the paper mills dependent upon them turned to the study of the pulping of flax fiber from domestic sources. The amount of flax fiber grown for textile purposes is too insignificant to warrant the attention of the paper manufacturer.

The Bureau of Plant Industry, U. S. Department of Agriculture, carried out between 1912 and 1920 extensive investigations on the use of flax straw obtained as a by-product from the production of flax seed for linseed oil. During this period the belief was prevalent that the fiber from seed flax was incapable of use in fine paper manufacture on account of fundamental differences between it and flax fiber used for textile purposes. Jason L. Merrill, paper and plant chemist on the Bureau staff, made paper on a laboratory scale, however, which had all the physical characteristics demanded for currency and definitely proved that seed flax fiber could be used.

The studies were continued at the Forest Products Laboratory in the 1920's. Mechanical decortication was practiced in order to eliminate as much as possible of the nonbast constituents of the straw which contributed little to the desirable fiber desired for banknote paper; this greatly reduced the amount of cooking chemical necessary to properly pulp the residue.

The tow produced by decortication amounts to about 27% of the weight of straw treated. Beyond this point the loss of bast fiber discourages further mechanical separation. Proper retting of the straw in the field renders the separation more complete but the proper control of the retting is beyond the capability of the average farmer or baler. It was left to the mill pulping the so-called fine tow to prepare the material for satisfactory use in the paper mill. After extensive pulping studies, in which an exhaustive survey of a multitude of pulping agents was made, it seemed apparent that any agent that is capable of pulping the nonbast constituents remaining in the tow would degrade the cellulose content of the bast so much that the special properties for which the bast fiber was chosen were lost. The only cooking agent found that did not degrade the cellulose beyond usefulness for exacting papers was milk of lime, but this agent was found incapable of resolving the shives present in the tow to the point where they could be removed by washing and bleaching.

Cigaret paper is one of the products for which the linen fiber is particularly desirable. Papers made from the cotton fiber or high-grade chemical wood pulps produce a smoke on burning which is disagreeable to the smoker. This is not encountered when linen fiber is used. Foreign sources produced most of the cigaret paper formerly used in the United States and a real crisis threatened when a second world war loomed which would inevitably cut off the sources of foreign cigaret paper in the late 1930's. Domestic manufacturers, as well as one large importer of foreign cigaret paper, saw this threat so that the use of flax tow derived from flax straw was studied intensively.

Fortunately, a certain amount of degradation of the cellulose in pulping and bleaching flax tow for cigaret paper could be countenanced and, by building a new plant and by adapting and improving existing plants, enough capacity was provided to supply the domestic demand for cigaret paper made from seed flax straw. Although the total tonnage of cigaret paper is small, judged by that used in many other grades, it is apparently profitable to those engaged in the industry. It is now adequately supplied by a domestic source of fiber which should be capable of expansion to something like ten times its present magnitude, provided a reasonable degree of organization and interest in the chemurgic and conservational aspects of the subject occurs. Table I presents the acreage devoted to the culture of flax seed as reported by the Bureau of Census, Department of Commerce, at 10 or 5-yr. intervals between 1889 and 1949. It occurs most concentrated in the areas along the border of Minnesota and North and South Dakota. In the period covered, the total acreage harvested varied from 998,031 to 4,812,695 acres. An average of approximately three fourths of a ton of straw is obtained per acre of flax grown. The presence of weeds is objectionable from the standpoint of producing a high-grade fiber and the vagaries of weather have an important effect upon the yield. It is also important to pay the farmer enough for the straw to induce him to use sufficient care to deliver the straw without deterioration and in shape for decortication and pulping to produce the highest quality of which the fiber is inherently capable. If this is done, the use of the fiber can be extended as part of the furnish in the manufacture of many grades of banknote, ledger, Bible, onionskin, linen, vellums, and other grades which command a price which will permit the manufacturer to afford to pay for a highly selected fiber which corresponds to less than one tenth of the weight of the flax straw from which it was processed. Under these conditions, the extent of the market which can be developed should amount to many times the outlet offered by the manufacture of cigaret paper.

The work that has been done in the past century on the pulping of flax tow by chemical means in the conventional rotary digester has quite clearly demonstrated that there is no pulping agent commercially available that is capable of softening or pulping the shive that occurs in any of the grades of flax tow available without degrading the cellulose in the bast fiber beyond the point where it can be used in the highest grades of banknote paper. By mechanically disintegrating the flax straw in swing hammer shredders modified with fixed arms and with a suitable grating and by screening out the fiber on rotary screens, the fiber content of the screened fluff is upgraded by the removal of two thirds of the material in the straw as shive. The screened tow is then treated in a Marcy rod mill at about 7% moisture content to further disintegrate the remaining shive. Rotary screens remove the disintegrated shive so that the weight of fiber to be treated amounts to only one sixth of the weight of the original straw. Conversely, the weight of bast fiber per ton of product is six times the weight of bast fiber that is present in a ton of straw

SIDNEY D. WELLS, Research Associate, The Institute of Paper Chemistry, Appleton, Wis.

The upgraded fiber has been obtained with the elimination of 83% of the weight of the original straw without any degradation of the cellulose in the bast. The action of the rods in the Marcy rod mill is selective to a considerable degree in shattering the shive so that it can be removed by screens with comparatively moderate shortening of the bast. It is still long enough for papermaking purposes and much of the arduous work required in the washing, pulping, and bleaching of rag stock is avoided.

amounts to 12%. It is then apparent that the treatment consumes caustic soda amounting to 6% of the dry weight of the fluff.

The stock after draining is washed from the diffuser, using spent liquor, to a vacuum filter and finally washed with water. The liquor from the filter is run to the spent liquor tank containing spent liquor of the same gravity test.

The fluff, after treatment with dilute caustic soda for 3 days and washing, is run through a Bauer refiner with the disks set

Table I. Acreage Devoted to Flax Seed Culture in the United States, 1889–1949

	1889	*1899*	*1909*	*1919*	*1924*	*1929*	*1934*	*1939*	*1944*	*1949*
New England	26	5	7	10	...	...	5	...	...	...
Middle Atlantic	3,441	234	130	108	43	102	50	95	...	5
Ohio	20,553	3,092	552	76	74	190	118	181	39	...
Indiana	2,737	171	39	13	...	13	48	359	440	...
Illinois	4,672	394	115	105	305	196	529	380	972	...
Michigan	417	883	261	1,297	681	2,301	8,773	7,414	5,735	9,324
Wisconsin	5,973	11,263	9,423	7,133	6,700	6,610	5,209	7,643	4,645	15,997
Minnesota	303,635	566,801	358,426	288,240	683,270	511,792	620,551	1,211,375	817,218	1,638,870
Iowa	230,085	126,453	15,549	9,646	7,889	12,808	16,352	100,806	90,794	109,810
Missouri	56,421	100,952	20,630	399	2,368	1,919	4,169	3,976	...	...
North Dakota	43,724	773,999	1,068,049	649,949	1,873,744	1,338,961	239,407	312,052	763,111	1,775,884
South Dakota	354,951	302,010	518,566	159,234	584,236	669,313	13,756	146,863	291,098	676,232
Nebraska	163,900	7,652	2,934	1,344	2,840	19,719	163	642	368	...
Kansas	114,069	192,167	45,014	12,368	56,564	19,756	56,298	95,369	84,503	30,448
South Atlantic	311	17	19	1	...	6	13	34	5	...
East South Central	203	5	4	65	...	...	...	...	...	...
West South Central	74	3,659	1,414	184	575	98	168	11,281	77,226	311,564
Mountain	8,424	17,691	41,731	130,174	251,732	380,785	20,929	86,953	200,870	89,276
Pacific	5,082	3,069	279	341	94	1,060	11,493	96,074	140,043	155,290
Total U.S.	1,318,698	2,110,517	2,083,142	1,260,687	3,435,115	2,965,635	998,031	2,081,497	2,477,070	4,812,695

The fiber or fluff is charged in rotation to diffusers shown in Fig. 1. They are provided with false bottoms made of perforated stainless sheet steel. After a diffuser is charged with fluff, it is filled with spent liquor which has been used twice before and, on account of the natural wetting agents derived from the fluff in the earlier runs, wetting proceeds without delay. After a soaking period of about 24 hr., the alkali has been utilized completely at room temperature and it is sent to recovery or allowed to run to the sewer.

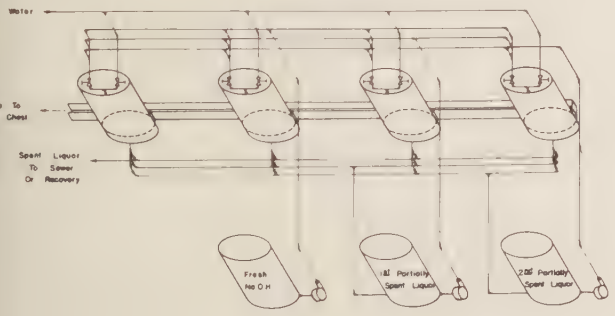

Fig. 1

After the treatment with partially spent liquor from two earlier treatments and disposal of the totally spent liquor, the diffuser is filled with liquor that has been used once and allowed to stand for 24 hr. It is then drawn off and used to treat a diffuser of untreated fluff. Then in rotation the stock is finally treated with a fresh solution of caustic soda containing the alkali amounting to 6% of the weight of the dry weight of the fluff. In the diffuser the consistency of the stock

with the micrometer reading at 0.001 in. The freeness of the pulp is about 860 ml. Schopper-Riegler.

The stock after pulping in the Bauer refiner is similar in physical characteristics to kraft pulp from pine and passage through a Vortrap removes 6.39% of shive which still remain. The product is chlorinated at about 2% consistency using 7.5% of chlorine. The pulp is then washed and given a caustic soda extraction using 2.0% of sodium hydroxide, which is followed by a water wash. The stock is then bleached in a Dilts beater using 2.3% of chlorine in the form of calcium hypochlorite. After a treatment lasting 115 min., the batch is washed and made into handsheets.

The pulp obtained had a brightness of 84.4 and a cuprammonium viscosity of 138.3, which indicates a degree of polymerization (D.P.) of 1850.

Table II

	Shive	*Fines*
Cellulose, %	52.4	44.9
Pentosan, %	21.5	16.2
Lignin, %	26.6	22.9
Ash, %	3.2	6.3
Protein, %	2.9	6.3
Alcohol-benzene soluble, %	3.3	6.7
Hot-water soluble, %	6.4	13.5
B.t.u. per lb.	9333	9105

In actual manufacture it is generally conceded that maintenance of a D.P. in excess of 1700 will yield a stock suitable for banknote manufacture. The operation outlined produced a stock with a D.P. of 1850 which exceeds by an ample margin this requirement. It is apparent that neither the mechanical decortication of the flax straw nor the treatment with dilute caustic at room temperature was injurious to the fiber, and

that this fiber could be subsequently bleached to a high white and with elimination of shive to the extent that they were not visible in the final product.

The waste product from the decortication of the flax straw is available for fuel to generate steam for power and heating the drier for drying the straw to the optimum moisture for decortication. Analyses of the shive and the fines obtained in the operation are shown in Table II.

The products from the mechanical decortication of 100 tons of chaff-free straw are shown in Table III.

Table III

Shive used for fuel	50 tons
Fines	32.5 tons
Fiber	17.5 tons

Further treatment of the fiber as outlined above gave the yields shown in Table IV (based upon the oven-dry weight of the untreated flax fluff).

Table IV

From treated flax fluff after refining in Bauer and washing in Dilts beater washer, %	82
After Vortrap, %	75
After chlorination and caustic extractions, %	72
After bleaching with hypochlorite and washing, %	67.3

The freeness of the stock after the final wash in the Dilts beater washer was 840 ml. Schopper-Riegler. Other runs gave freenesses ranging from 785 to 575 ml. Schopper-Riegler.

Handsheets were made for strength evaluation of the stock obtained from the conditions shown in Table IV, using the standard procedure developed for evaluating chemical wood pulps. The results obtained are shown in Table V.

The shives obtained from the mechanical decortication of the flax straw amount to 50% of the straw and, with its high calorific value of 9330 B.t.u. per lb., would provide ample fuel for power to run the machinery involved in the operation, together with the treatment of the fine fluff in the subsequent operations. Drying of the bleached pulp sheets for shipment to eastern fine paper mills can also be included if found to be desirable.

The fines derived from the mechanical decortication contain considerable food value and should be of interest for the preparation of stock feed. Operation on a large enough scale to make it worth while is necessary to realize the potential possibilities of the flax fiber. The example set by the manufacturers of bleached pulps on the Pacific Coast should be used so far as possible as a precedent.

The flow sheet indicated in this report was developed through the availability of the flax fluff equipment at the plant of the Grutzmacher Flax Co. near Ripon, Wis. Victor Grutzmacher superintended the operation of the plant which had a capacity of about 1000 lb. of fine fluff per 8-hr. day. With such a plant, facilities can be provided without excessive expense to complete the pulping and bleaching of adequate quantities of material to test it in various furnishes for commercial runs and to ascertain on a mill scale how satisfactorily the new fiber fits into the furnishes of any fine paper mill that may be interested.

The general flow sheet followed in this work is disclosed in U. S. patent no. 2,452,533 (Oct. 26, 1948), assigned to The Institute of Paper Chemistry, and was used in conjunction with the cold caustic treatment, on which patent application is pending.

Table VI

	TAPPI viscosity, cp.	*Final brightness (GE), %*
American-made cigaret paper	8.7	..
Flax air-mail paper	8.4	..
Pulp submitted by manufacturer no. 1	4.8	..
Pulp submitted by manufacturer no. 2	31.6	..
Pulp prepared from Ripon fluff		
No. 1	68.8	..
No. 2	62.2	..
No. 3	99.5	..
No. 4	78.2	..
No. 5	100.7	..
No. 6	149.1	..
No. 7	151.2	..
No. 8	138.1	..
No. 9	112.0	..
No. 10	258.2	..
No. 11	197.0	..
No. 12	136.5	..
No. 13	169.6	..
No. 14 Fluff treated with 7% bleach and extracted with 3% caustic at 25°C.		
Bleached with 2% bleach as hypochlorite	83.2	88.3
Bleached with 3% bleach as hypochlorite	33.1	88.0
Bleached with 4% bleach as hypochlorite	16.8	88.9
Run no. 10 Ripon fluff after cold caustic but before bleaching	112.0	..
The same after alcohol-benzene extraction	136.5	..
After bleaching and washing	258.2	..

It is apparent that each step must be governed by the results obtained and the tolerance ascertained to give the final characteristics desired. The sensitivity of the stock to the final bleach is particularly important.

Table V

Beating time, min.	*S.-R. freeness, ml.*	*Basis weight (25 × 40—500), lb.*	*Caliper, in.*	*Apparent density*	*Mullen burst, pts. per 100 lb.*	*Elmendorf tear factor*	*M.I.T. fold*	*Schopper tensile, lb. per in. per 100 lb.*	*Schopper stretch, %*	*B & L opacity, $R_0/R_{0.89}$*
0	780	...	...	..	..	..	..	..	..	..
5	705	46.3	0.0044	10.5	59	2.38	78	33.3	3.3	74.0
13	570	45.2	0.0041	11.0	71	2.15	336	40.3	2.7	74.5
18	530	47.4	0.0041	11.6	81	2.03	392	46.6	3.6	74.5
24.5	405	45.7	0.0037	12.4	88	1.95	437	47.0	3.2	73.5
31	345	46.5	0.0037	12.6	88	1.78	701	51.2	3.1	73.0

The results reported above were obtained with the optimum combination of mechanical decortication followed by the various operations outlined above. In arriving at these results, many runs were made and evaluated in which TAPPI viscosity tests were made of the product. Some of these runs either failed to maintain the viscosity requirement of 100 cp. or the appearance of shives was not completely avoided, but are included for the information of the reader. The data obtained are given in Table VI.

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NATIONAL MEETINGS

Fourth Coating Conference, Netherland Plaza Hotel, Cincinnati, Ohio, May 25–27, 1953.

Second Conference on Application of Statistical Methods in the Pulp and Paper Industry, Western Michigan College, Kalamazoo, Mich., June 15–26, 1953.

Eighth Engineering Conference, Sheraton-Mt. Royal Hotel, Montreal, P. Q., October 26–29, 1953.

Seventh Alkaline Pulping Conference, Rice Hotel, Houston, Texas, November 18–20, 1953.

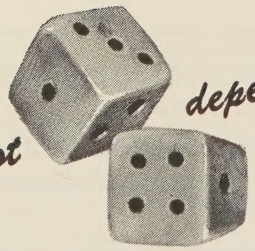
Thirty-ninth Annual Meeting, Commodore Hotel, New York, N. Y., February 15–18, 1954.

EMPIRE STATE SECTION:

Whiteface Inn, Lake Placid, N. Y., June 8–10, 1953.

NEW ENGLAND SECTION AND MAINE—NEW HAMPSHIRE SECTION:

Poland Spring House, Poland Spring, Maine, June 19–20, 1953.



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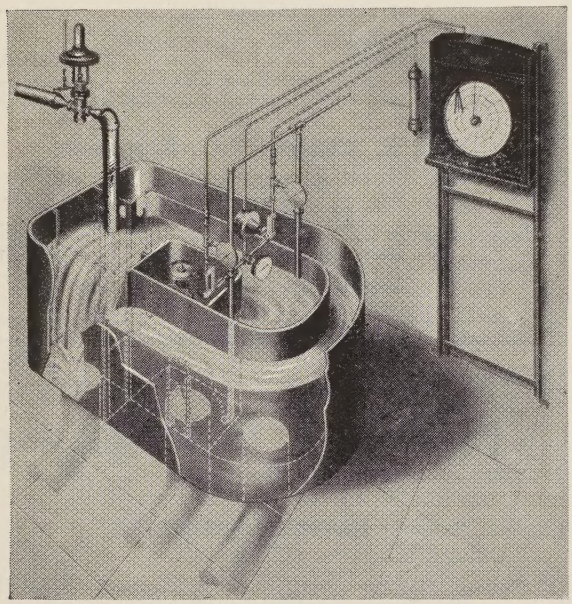

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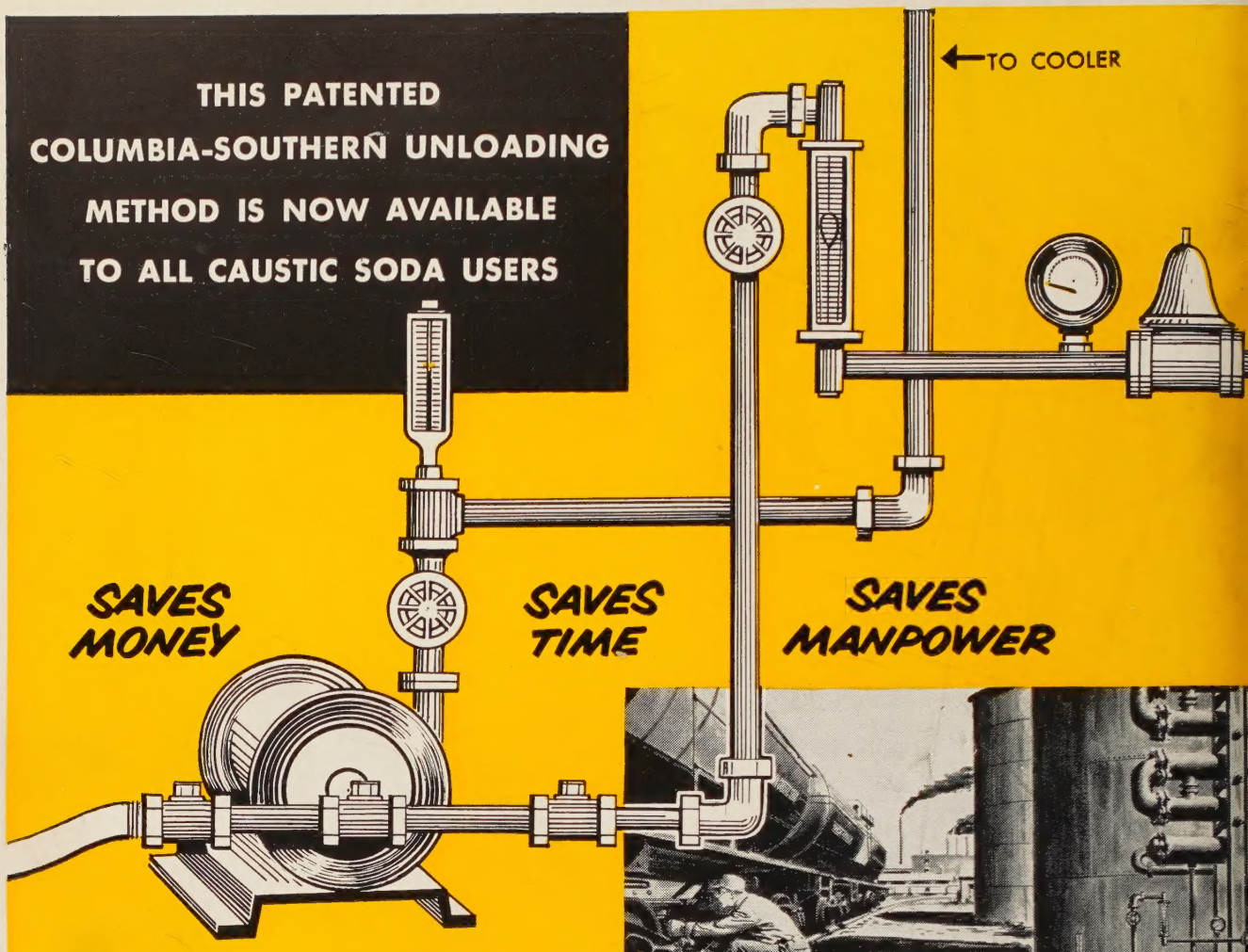

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